Environmental Advisory Committee
4:00 p.m., Thursday, March 14th, 2024
Council Chambers
1207 Palm Boulevard, Isle of Palms, SC 29451

Agenda

1. **Call to order** and acknowledgment that the press and the public have been duly notified of the meeting in accordance with the Freedom of Information Act

2. **Citizen's Comments**

3. **Approval of previous meeting's minutes –** February 21st, 2024

4. **Presentations**

5. **Old Business**
    i. Wildlife- discussion of native plant exhibition and classes

    ii. Litter- discussion of belly board waste

    iii. Water Quality- update on potential water quality testing program

    iv. Climate Action-
        a. update on grant requests
        b. Discussion of follow-up composting training class
        c. Update on Charleston County recycling

    v. Update on Sea Level Rise Adaptation RFP

6. **New Business-**

    i. Todd D. Krafft Septic Health Initiative Program in Naggs Head

7. **Miscellaneous Business**

    Next meeting date: 4:00 p.m., Thursday, April 11th, 2024

8. **Adjournment**

ENVIRONMENTAL ADVISORY COMMITTEE
4:00pm, Wednesday, February 21, 2024
1207 Palm Boulevard, Isle of Palms, SC
and broadcasted live on YouTube: https://www.youtube.com/user/cityofisleofpalms

MINUTES

1. **Call to order**

Present: Sandra Brotherton, Mary Pringle, Belvin Olasov, Todd Murphy, Laura Lovins, Doug Hatler, Dane Buckout, Lucia Spiotta

Absent: Jordan Burrell

Staff Present: Director Kerr, Zoning Administrator Simms, Council Member Miars

2. **Citizen's Comments -- none**

3. **Approval of previous meeting's minutes**

MOTION: Mr. Murphy made a motion to approve the minutes of the January 17, 2024 meeting, and Ms. Lovins seconded the motion. The motion passed unanimously.

Dr. Brotherton asked the new members, Laura Lovins, Dane Buckout, Todd Murphy, and Lucia Spiotta, to introduce themselves to the Committee members.

4. **Old Business**

A. **Wildlife**

Ms. Pringle said a purple martin house has been put on the property at 7th and Palm. The site preparation for the garden will be February 29 and the planting will be on March 14.

Dr. Brotherton corrected the date for Sharlene Johnson's class on Gardening with Native Plants for Butterflies at the Recreation Center to Tuesday, February 27.

Director Kerr shared that the Water & Sewer Commission approved of the Committee's plan to install a native plants and grasses garden on their property at 7th and Palm. He is waiting on their attorney to send the licensing agreement.

Zoning Director Simms said the grant to help pay for the plants in the garden at 7th and Palm and for Sharlene Johnson's classes at the Recreation Center has been submitted.

B. **Litter**

Dr. Brotherton reported that she and Susan Smith spoke with Dennis at the Harris Teeter about offering higher quality belly boards instead of the ones that are made of Styrofoam. He was

receptive to not stocking the lower quality belly boards, but he needs to sell the ones that have already been sold (about 2-3 weeks' worth). Ms. Smith has been in contact with the beach shop on the Connector to speak with them about the same issue.

C. **Water Quality**

Mr. Hatler reviewed the efforts and current goals of the Water Quality Subcommittee for the benefit of the new members. Referencing the proposal he sent to Committee members, he proposes requesting City Council for the funds for one round of water quality testing to establish a baseline of the chemicals found in the island's stormwater runoff. Based on the outcome of that testing, he would like to speak with DHEC about how to manage those outcomes that may indicate higher levels of some chemicals. He believes the $8,000 cost is minimal to understand the water quality coming off the island. He asked Committee members for their feedback on the proposal. He will make any necessary edits and present the final proposal to the Committee next month for their recommendation to City Council.

Discussion ensued about septic tanks and the long-term plan to sewer the entire island. Ms. Lovins and Mr. Hatler shared they had each spoken with Chris Jordan of the Water & Sewer Commission about the Commission's current work and future plans and could craft a presentation to share with the Committee.

D. **Climate Action**

Zoning Administrator Simms said he should hear about the solar panels grant in about 3 months.

Committee members discussed the Solid Waste Grants being offered by DHEC. Zoning Administrator Simms will reach out to Katie McKain for some clarity on the grant. The deadline is April 5, 2024.

Ms. Pringle said more educational outreach is needed about the City's glass recycling and food composting programs. She suggested additional training sessions and home composting bins for food composting.

Ms. Lee said the City will host a Shred Day on April 23. Charleston County will no longer send a truck for hazardous waste recycling, but residents can drive those materials to the recycling center in Awendaw.

Mr. Hatler suggested that perhaps the Solid Waste Grant could be used to hired someone with a truck to collect and properly dispose of the hazardous wastes.

Ms. Pringle asked what the Committee is intending to do as part of Sullivans Island's Earth Day celebration on April 27. Dr. Brotherton asked Committee members to review the 2023 Accomplishments List and send her any revisions or additions. This document can be part of what is handed out at the Earth Day celebration. Ms. Lovins said she will be there with information about the shorebirds. Director Kerr said he will contact Sullivans Island about securing a table for the Committee.

E. **Update on Sea Level Rise Adaptation RFP**

Director Kerr said there is no update on this plan.

F. **Breach Inlet Update**

Director Kerr said City Council enacted a 60-day emergency ordinance last night allowing hard erosion control structures 20' from a home. He explained the ordinance was done as an emergency ordinance so that relief could be provided to homeowners immediately without having to go through the longer process of approving a zoning ordinance. He expects that there will be a discussion in the future about a permanent change to that part of the City code.

Mr. Olasov expressed concern about the worsened erosion conditions for those that do not put up a seawall. Council Member Miars said the City does not want seawalls along the beach either, but they also don't want homes in the ocean.

Director Kerr shared the beach monitoring efforts of the City that have been ongoing for many years. He also said the newly formed Beach Ad Hoc Committee is discussing the City's future needs regarding beach preservation and how to fund such efforts. He also explained that homeowners who opt to install a seawall must get a permit and have OCRM come mark their property before any work is done. He said that anyone who builds a seawall is no longer able to request emergency sand scraping or sand placement in front of their home.

5. **New Business**

6. **Miscellaneous Business**

Dr. Brotherton asked about the creation of a repository-type space on the City's website that can house information created and shared by the Committee. Director Kerr suggested reaching out to the City's PR Officer directly about that webpage.

Ms. Pringle said Cyndy Ewing would like to make a presentation at next month's meeting.

Ms. Lovins shared information about a talk the Sierra Club is giving next month on septic conflicts in the Lowcountry.

7. **Adjournment**

The next meeting of the Environmental Advisory Committee is tentatively scheduled for Thursday, March 14, 2024 at 4pm.

Mr. Hatler made a motion to adjourn, and Mr. Murphy seconded the motion. The meeting was adjourned at 5:47pm.

Respectfully submitted,

Nicole DeNeane
City Clerk

From: Energy Customer Service
To: Matt Simms; Douglas Kerr; Debra Hamilton
Subject: [EXTERNAL] SC EECBG Competitive Program notification
Date: Thursday, February 29, 2024 1:06:32 PM
Attachments: image.png
inky-injection-inliner-209b06d63f3139b7bbda7129634c80da.png
inky-injection-inliner-03755809cc10337ec572b1f12a6beedf.png
Importance: High

[EXTERNAL]

Caution: External (energycs@ors.sc.gov)

First-Time Sender

GUARDIAN

Hello Matt Simms,
We are pleased to inform you that the City of Isle of Palms' application to the SC Energy Efficiency and Conservation Block Grant (EECBG) Competitive Subgrant Program (SC EECBG Competitive Program) for the *Public Works Department Rooftop Solar* project has received preliminary approval for $67,261 in funding. Final selection for an award under the SC EECBG Competitive Program is subject to approval of the US Department of Energy (DOE) and execution of an Award Agreement with the Office of Regulatory Staff – SC Energy Office (SCEO).

Please do not complete any work or incur any costs associated with the project until you receive a signed and fully executed Award Agreement from SCEO. Additional information is forthcoming regarding award announcements, reporting requirements, and the Award Agreement.

Thank you for your application, and please contact us if you have any questions.

Best regards,

SC Energy Office EECBG Team

ENERGY OFFICE

ENERGY.SC.GOV

TOWN OF

Nags Head

NORTH CAROLINA

Decentralized Wastewater Management Plan

SPRING 2022

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Acknowledgements

Town of Nags Head; Board of Commissioners

Ben Cahoon, Mayor

Mike Siers, Mayor Pro Tempore

Renée Cahoon, Commissioner

Bob Sanders, Commissioner (November 2021 election)

Webb Fuller, Commissioner (former)

Kevin Brinkley, Commissioner

Town of Nags Head; Planning Board

Megan Vaughan, Chair

Kristi Wright, Vice Chair

David Elder

Megan Lambert

Meade Gwinn

Gary Ferguson

Molly Harrison

Town of Nags Head; Staff

Andy Garman, Town Manager

Kelly Wyatt, Planning & Development Director (current)

Michael Zehner, AICP (former Planning & Development Director)

Holly White, AICP, CFM, Principal Planner

Kylie Shephard, Project Manager, Environmental Planner

David Ryan, Town Engineer

Kate Jones, Senior Environmental Planner

Town of Nags Head; Decentralized Wastewater Management Plan Advisory Committee

Basil Belsches

Dave Herrmann

Bob Muller

Bill Simmonds

Contributors

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Hillary Yonce, PH, Tetra Tech

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Bobby Tucker, PE, Tetra Tech

Mary Clark, Mary Clark Consulting

Dr. Michael O'Driscoll, ECU CSI

Charlie Pittman Humphrey, ECU

Dr. A. Robert Rubin, NCSU, A. Rubin and Associates

Katie Hill, University of Georgia

Vic D'Amato, PE, NC DEQ DWR

Dedication

In 2019, the Town of Nags Head renamed the Septic Health Initiative the Todd D. Krafft Septic Health Initiative in honor and memory of Todd. D. Krafft for his tireless efforts in promoting the Decentralized Wastewater Management Plan and Septic Health Initiative program.

Todd Krafft speaking at the Town of Nags Head Memorial Day Ceremony, May 2019.

Tetra Tech Engineering, PC
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tetratech.com

Town of Nags Head

Decentralized Wastewater Management Plan

May 4, 2022

PRESENTED TO

Town of Nags Head
5401 Croatan Highway
Nags Head, NC 27959

PRESENTED BY

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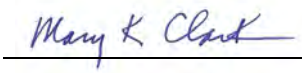
Prepared by:

5/4/2022

Holly E. Miller, PE, CPESC, CFM — Date

Project Manager, Tetra Tech

Reviewed by:

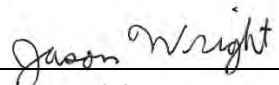


5/4/2022

Mary Clark — Date

Assistant Project Manager, Mary Clark

Authorized by:



5/4/2022

Jason Wright, PE — Date

Principal, Tetra Tech

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Tables, Maps, Figures, and Acronyms

Tables

Figures/Maps

Acronyms/Abbreviations

Acronyms/Abbreviations	Definition
APNEP	Albemarle-Pamlico National Estuary Partnership
AC	Advisory Committee
ATU	Advanced Treatment Unit
BOD	Biological Oxygen Demand
CIP	Capital Improvement Project
CAMA	Coastal Area Management Act
CWA	Clean Water Act of 1972
DCEH	Dare County Environmental Health
DWMP	Decentralized Wastewater Management Plan (The Plan)
ECU CSI	East Carolina University Coastal Studies Institute
EOP	Engineer Option Permit
EPA	US Environmental Protection Agency
FC	Fecal Coliform
FOG	Fats, Oils, Grease
FT, ft	Foot/feet
GIS	Geographical Information Systems
GSI	Green Stormwater Infrastructure
GPD, gpd	Gallons Per Day
GW	Groundwater
HMP	Hazard Mitigation Plan
HOA	Home-Owners Association
IN, in	Inches
LID	Low Impact Development
LPP	Low Pressure Pipe
LSS	Licensed Soil Scientist
LTAR	Long Term Acceptance Rate

Acronyms/Abbreviations	Definition
MCDA	Multi-Criteria Decision Analysis
MSL	Mean Sea Level
NCDEQ DWR	North Carolina Department of Environmental Quality Division of Water Resources
NC DHHS, NC DHHS DPH EHS	North Carolina Department of Health and Human Services Division of Public Health Environmental Health Section
NCSU	North Carolina State University
N	Nitrogen
NO_3^-	Nitrate Nitrogen
NO_2^-	Nitrite Nitrogen
NH_3	Ammonia Nitrogen
NH_4^+	Ammonium Nitrogen
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NSF	National Sanitation Foundation
O&M	Operation and Maintenance
OBX	Outer Banks
OSDS	Onsite Sewage Disposal System
OSWPB	On-Site Wastewater Protection Branch (NC DHHS)
OWTS	Onsite Wastewater Treatment Systems (Septic Systems)
PPBPS	Prefabricated, Permeable Block Panel System
PSA	Public Service Announcement
RWTS	Residential Wastewater Treatment Systems
SCM	Stormwater Control Measure
SHI	Todd D. Krafft Septic Health Initiative
SLR	Sea Level Rise
SMART	Specific, measurable, attainable, realistic, and timely

Acronyms/Abbreviations	Definition
STEP	Septic Tank Effluent Pump
Town, town	Town of Nags Head
TKN	Total Kjeldahl Nitrogen = Organic N + Ammonia (NH3) + Ammonium ($NH4^{+}$)
TN	Total Nitrogen = Organic N + NO_3^- + NO_2^- + NH_3 = TKN + NH_3^- + NO_2^-
TP	Total Phosphorus
TSS	Total Suspended Solids
Type II	Conventional Septic System, 480 gpd or less
Type III	Gravity Fill, PPBPS, Non-Conventional Trench
Type IV	LPP, more than 1 pump/syphon, public or private with certified operator
Type V	Sand Filter, ATU < 3,000 gpd, public or private with certified operator
Type VI	System < 3,000 gpd, public with a certified operator
US EPA, EPA	US Environmental Protection Agency
VCAPS	Vulnerability, Consequences, Adaptation, Planning Scenarios
VSD	Vertical Separation Distance
WQ	Water Quality

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Executive Summary

The Town of Nags Head (Town) is a unique destination in the Outer Banks of North Carolina. It features natural areas like Jockey's Ridge State Park, Nags Head Woods, and Cape Hatteras National Seashore. It is situated in the Albemarle-Pamlico Estuary between the Roanoke Sound and the Atlantic Ocean. People are drawn to the town for recreation, relaxation, its beach-community charm, and high quality of life. Many of the enticements which draw visitors and new residents each year center on water. While seemingly abundant, the Town must work to protect this critical natural resource. The challenge here comes in selecting the most appropriate action to ensure long term-viability as environmental conditions change.

In 1999, the Town created a Septic Health Initiative (SHI) that provides homeowners with free septic system inspections, septic system pump out water utility bill credits, low-interest loans for septic system repairs or replacement, and water quality testing. With over 85% of the Town's wastewater being treated by onsite wastewater treatment systems (septic systems), the Town understood that proactive maintenance and repair of septic systems was vital to protect the ecosystem. In 2005, the Town conducted a technical study and developed the Decentralized Wastewater Management Plan (DWMP) and Final Technical Report. The two documents reviewed data related to septic system characteristics and water quality sampling and outlined a path forward for the Town to continue to improve and grow the initial SHI.

Since 2005, the SHI has continued to grow and in 2019 it was renamed the Todd D. Krafft Septic Health Initiative in memory of Todd D. Krafft who worked tirelessly to promote the SHI. This 2022 update of the Decentralized Wastewater Management Plan (the Plan) is dedicated to his memory and continues to build upon his outstanding work. The intent of this update is to evaluate the overall effectiveness of the current Plan and the town's SHI program, recommend additional measures, and expand and integrate the Plan, all while considering the relationship between onsite wastewater, stormwater, surface water, and groundwater.

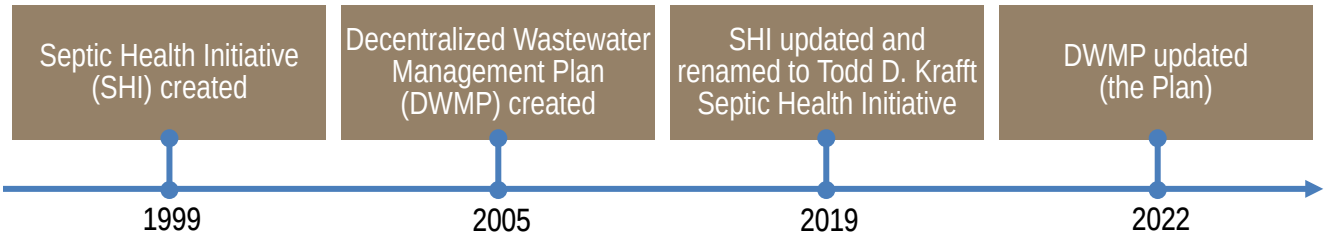


Figure 1-1. Timeline of SHI and DWMP updates

The purpose of the DWMP and SHI is to establish the promotion and implementation of decentralized wastewater management strategies for residents, visitors, and neighboring coastal communities. The Plan is a dynamic and evolving resource, designed to help decentralized systems remain a sustainable component of Nags Head's infrastructure. The updated Plan includes a detailed data analysis of the SHI program and relied on substantial input from the public and a wide variety of community stakeholders. This input was gathered through key stakeholder interviews, a public forum, and an online community questionnaire. A community Advisory Committee (AC) was also created. This group represented citizens of Nags Head and provided substantial input on the Plan development and recommendations to the SHI.

The Plan also includes programmatic and management recommendations for continual improvement as the Plan and SHI continue to grow.

The Town of Nags Head has developed meaningful partnerships and collaborations with multiple agencies, regulators, stakeholders, and community groups to support research on septic systems, groundwater, and water quality. Specifically for septic systems, research was conducted under several studies, including three University of North Carolina (UNC) Capstone Reports and a North Carolina State University (NCSU) Tipping Points Project. Each study provided significant insight into the community's understanding of water quality, regional perception of septic systems and septic system impacts due to flooding and rise in groundwater table elevations. One of the primary outcomes of the research and resulting studies concluded that additional education was needed to provide citizens the resources to understand the SHI program elements, septic system function, connection to water quality, groundwater table elevation changes, and impacts from flooding.

As part of the North Carolina Sea Grant, “Climate Change and Onsite Wastewater Treatment System on Coastal Carolinas” research was conducted by East Carolina University Coastal Studies Institute (ECU CSI) which evaluated existing onsite wastewater technologies under multiple climate conditions in the coastal Carolinas. In general, the State of North Carolina requires a vertical separation distance (VSD) between the drain field and the seasonal high-water table in sandy soils of 18 inches (1.5 feet). Since drain field lines are typically buried approximately 2 feet deep, this would require the groundwater table to be approximately 3.5 feet or deeper. The intent of the ECU CSI research is to obtain groundwater table elevations and aid coastal communities in cost-effectively and legally implementing climate adaptation plans for wastewater infrastructure.

As part of the Plan, ECU CSI obtained groundwater elevation data from six groundwater wells in Nags Head located at Wright Brothers National Memorial, Bonnett Street Beach Access, Dowdy Park, the Town of Nags Head Municipal Complex, Bodie Island, and a residential site in South Nags Head. The research concluded that three sites, including the residential property, Wright Brothers Memorial, and Bodie Island, had shallow groundwater tables, typically less than 3.5 feet deep. This suggests that the 18-inch (1.5 feet) required VSD between the bottom of the septic drain field and the groundwater table would likely not be met for conventional septic systems in these areas based on the sample elevations obtained. Two sites, including the Town of Nags Head Municipal Building and Dowdy Park, typically had groundwater table depths greater than 3.5 feet, and adequate VSD. And one site, Bonnett Street Beach Access, had deeper groundwater tables and had sufficient VSD for the period of record. Additionally, as part of the larger study the long-term NC DEQ groundwater level data suggests that groundwater levels in Dare County are rising at a similar or faster rate than sea level rise (0.433 inches/year). This may increase the number of sites with insufficient VSD and affect those which had greater than the required 1.5 feet of VSD when constructed. A recommendation of the Plan is to continue to monitor long-term groundwater table elevations in Nags Head by purchasing ten (10) additional remote groundwater data loggers and installing them in areas that are not adequately represented by existing wells (data gap), and that are likely to have high groundwater table elevations.

During key stakeholder interviews, participants provided several key takeaways that aided in shaping the Plan recommendations including education via the town webpage on septic systems, water usage, the benefits of the SHI program elements, providing free giveaways at festivals or events like a grease can lid or toilet flapper valve to save water, providing a welcome packet to new residents, and supporting the rental properties with targeted outreach materials. Recommendations also included coordinating with existing programs like NC Aquarium at Jennette’s Pier and Cape Hatteras National Seashore to allow visitors and citizens to make the connection between septic failure and water quality though hands on

educational programs, shifting the timing of inspections and pump outs to be offseason, obtaining paper records from Dare County Environmental Health on septic permit data, and developing an online data platform to aid in compiling the data and an online GIS map to locate septic systems. Other recommendations included developing a green business initiative to promote environmentally friendly businesses who maintain septic systems and support water quality efforts.

Lastly, many stakeholders were concerned about rising groundwater levels, flooding, and septic system failures but were not interested in converting the entire town to central sewer as this may change the character of the town with smaller lot sizes. Looking at alternative septic solutions like advanced treatment, decentralized cluster systems, or wastewater reuse in areas that are experiencing, or likely to experience, widespread septic failures should be considered in the future.

Stakeholders expressed support for the SHI program. Dare County Environmental Health, North Carolina Department of Environmental Quality, and North Carolina Department of Health and Human Services specifically wished others would follow the Town of Nags Head's lead in being proactive when it comes to septic systems. Recommendations from stakeholders to the SHI program included the addition of a voluntary septic system maintenance subscription service, a grant program to aid in replacements of a failed system and conversion of conventional septic systems to a more advanced treatment system, increased dollar amounts for pump out credits ($150), and higher loan amounts to accommodate additional fill needed and/or installation of advanced systems ($12,000).

As part of the 2022 Plan update, the SHI program elements and incentives were reviewed to determine effectiveness. The program provided an average of 150 septic system inspections conducted annually by the town with a total of 2,330 inspections completed since 2005. On average 31 septic system pump out water utility bill credits are issued each year with a total of 423 credits. In addition, 133 low-interest loans have been obtained for repair or replacement of septic systems with a maximum loan amount of $7,500. Lastly, the town has expanded its water quality and bacteria sampling to 23 locations across Nags Head including eleven (11) surface water sites, five (5) ocean outfalls, and seven (7) groundwater sampling sites with over 2,000 samples collected. Overall, the SHI program is providing a valued service to homeowners.

When septic systems are not maintained properly or have failed, excess bacteria and other pathogens, and key nutrients nitrogen and phosphorus from untreated septic effluent (wastewater) can be released into groundwater and/or surface water. Excess nutrients can cause harmful algal (cyanobacteria) blooms in surface waters; high levels of bacteria and other pathogens can impact groundwater and surface waters including triggering beach closures. As part of the Plan, water quality nutrient and bacterial sampling data that was collected by the town was analyzed to determine current water quality and resulting bacteria conditions. Monitoring data samples analyzed included water quality nutrients (nitrate nitrogen (NO_3^-), ammonia (NH_3), total phosphorus (TP)), and bacteria samples (fecal coliform, Enterococci, and *E. coli*). The resulting data analysis showed that NO_3^-, which is a primary indicator of the presence of septic effluent in surface water and groundwater, had highest concentrations in three locations in both surface and groundwater including Old Nags Head Cove, US 158/Town Hall, and in South Nags Head at Juncos Street. NH_3 which can indicate inadequate of nitrification in the septic system and is a more toxic form of nitrogen, had higher concentrations at Curlew Street and near Gallery Row. TP, which is a secondary indicator to the presence of effluent in surface water, was present but in low concentrations throughout town. Enterococci bacteria exceeded the US Environmental Protection Agency (EPA) criteria at most sample sites in both surface water and groundwater sites. Exceedances were more common on the soundside. *E. coli* exceeded criteria at multiple surface water sites and was not present in groundwater sites. Highest concentrations of *E. coli* were at the Red Drum Outfall at Mile Post 10.5,

Soundside Outfall, South Old Road, Harvey Soundside Park, and South Nags Head ditch near the intersection of South Colony South Drive and South Old Oregon Inlet Road and Mile Post 21. The sample set for fecal coliform was for only two years and had exceedances in both surface water and groundwater sites including Gallery Row, Curley Street, South Nags Head at Juncos Street, and South Nags Head ditch and outfall near the intersection of South Colony South Drive, South Old Oregon Inlet Road, and Mile Post 21.

While the data provided potential septic system failure “hot spots” represented by water quality and bacteria exceedances, the monthly water quality sampling monitoring data makes it difficult to correlate septic failures to each exceedance. An additional recommendation of this Plan is to add six (6) additional water quality and bacteria sample locations with remote loggers near current areas of exceedance or “hot spots” to cover gaps and to increase sample frequency. This will expand the sample data set to aid in pinpointing water quality and bacteria exceedances and will allow for the collection of more frequent data to rule out natural occurrences and seasonal variability.

The of the recommended action items outlined in the Plan are SMART goals (specific, measurable, attainable, realistic, and timely) for programmatic elements under the SHI. Setting SMART goals will aid the Town in achieving each goal by FY2027, further promoting the SHI, and continuing to increase proactive septic system maintenance. Each goal should be reviewed annually and adjusted accordingly as staffing and budget allow. Goal number one is to increase the number of small residential septic system inspections from 150 to 500 annually by FY2027. Goal number two is to increase the total number of septic system pump out credits issued from 31 to 250 annually (half the number of inspections) by FY2027. Outreach and education should be targeted to areas that have a higher risk for septic system failure. This includes promoting the program to new homeowners through increased town webpage presence, SHI social media posts, SHI YouTube videos, welcome packets, and increasing the pump out credit to half the cost of a septic system pump out (i.e., $150). Overall, these goals aim to reach a larger percentage of small residential septic system users as more systems are aging, and onsite conditions may be changing as climate conditions change. Tracking effectiveness by compiling all the SHI program element data into a central repository (data management platform) paired with an Excel database of parcel information will greatly benefit the town to ensure consistency, ease of use, and allow for annual SHI program incentive and metric reporting.

Lastly, during the stakeholder interviews, the concept of a voluntary septic subscription service was raised by multiple parties. Many homeowners were unable to recall when they last inspected or pumped out their septic system. Overall, homeowners felt that there was a heavy burden of responsibility on maintenance of septic systems, components were unfamiliar, and they felt unsure of how to proactively maintain their systems. Development of a voluntary septic subscription service that automates inspection and maintenance of septic systems on a reoccurring basis would lessen the burden on the homeowner and be placed upon the town or management entity. It is recommended that the town create a subcommittee to develop recommendations on the organization and operational details of the voluntary septic system subscription service.

As conditions change in Nags Head so does the Town’s vulnerability. Considerations include changes typically associated with climate change such as increased precipitation, sea level rise, flooding, storm surge, erosion, and impacts to groundwater table elevations. These future changes can be examined independently and in conjunction with one another as one future condition can impact or exacerbate another. This is most evident in Nags Head with the observation of increases in more frequent, high intensity rainfall events combined with high groundwater tables that result in localized flooding which can affect septic systems and cause failures. As part of the Plan, a town-wide septic system risk assessment

evaluation was conducted. This parcel-based geospatial data evaluation identified sites that are most susceptible to septic system failure and pose the greatest risk to environmental and human health. Risk assessment analysis evaluation metrics were selected based on data availability and the likelihood of potential environmental and human health risk factors associated with a potential septic system failure. Metrics included land surface elevation, depth to groundwater, proximity to stormwater infrastructure, proximity to surface water including all waterbodies, proximity to environmentally sensitive areas, and observed poor surface water quality. Sites were scored based on specific assessment criteria that were weighted for relative importance, with composite scores calculated as a function of relatively low, medium, or high risk. Low-risk areas comprised of 1,512 parcels (42%), medium-risk areas identified 1,787 parcels (48%), and areas identified as high-risk areas included 428 parcels (11%). High-risk areas included areas on the soundside (West Soundside Road, Southridge, Roanoke Sound Shores, and Old Nags Head Cove; South Nags Head), parcels adjacent to the National Seashore west of S. Old Oregon Inlet Road (SR 1243), and along the Causeway Area at Pond Island and The Lone Cedar Village.

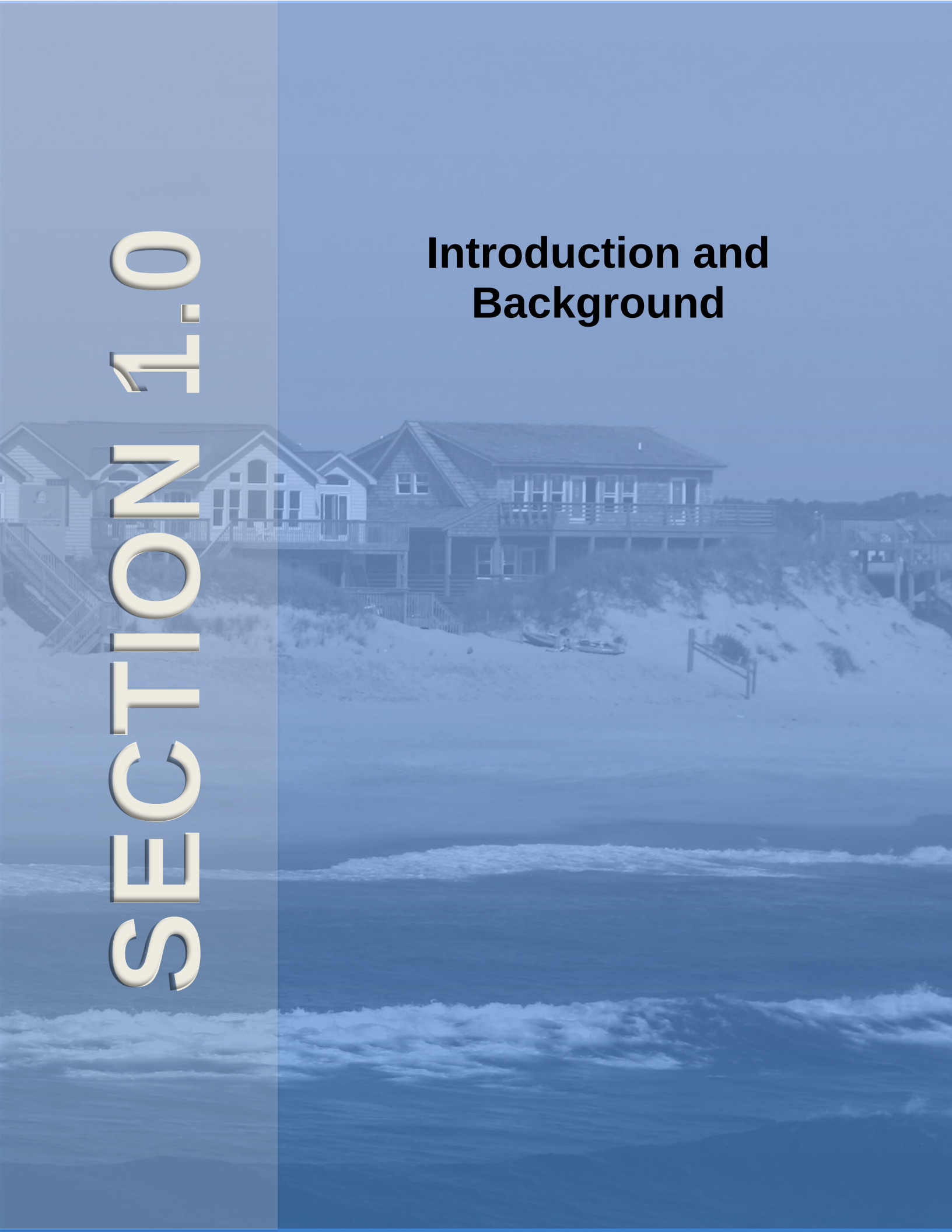
The resulting “hot spots” with medium and/or high risk can be further investigated by the town for vulnerability. The town may also wish to conduct specifically targeted outreach under the SHI program. Parcels with increasing risk may require more advanced treatment options for onsite septic systems that include the use of approved technologies to improve wastewater effluent treatment.

Additional recommendations to ensure septic system viability include the development of future condition scenarios and risk ratings based on monitoring data, groundwater studies, and the NC Climate Science Report to determine the probability of parcels moving from a low to medium or medium to high-risk and revision of septic management accordingly. The hot spot risk analysis for single-family parcels with existing onsite systems is intended to help the town with decision-making related to mitigation of septic failures, reduction of both environmental and human health risk, and increase overall community resiliency. The development of a future Long-Range Septic System Viability Master Plan that further analyzes future conditions, includes additional site criteria, and develops a roadmap for long-range wastewater treatment options as conditions change within the Town of Nags Head is recommended under this Plan.

The Plan included the organization, scientific analyses and risk assessment of key data points, which will be a tool the Town can utilize to compile various SHI and permit information into one Excel file. The Plan and SHI provide a roadmap for the town to follow to ensure the long-term viability of wastewater treatment through the use of onsite septic systems. The Plan provides a host of prioritized recommendations and further studies to aid in increased proactive maintenance incentives for homeowners, additional monitoring, data collection and reporting, and consideration of community cluster systems to serve high-risk neighborhoods. Lastly, the Plan identifies options for funding sources for the town to obtain grants or loans to aid in SHI program implementation.

SECTION 1.0

Introduction and Background



1.0 Introduction and Background

Since 1999, the Town of Nags Head has committed to improving onsite wastewater treatment (septic system) management and water quality under the Septic Health Initiative including septic system pump out water utility bill credit, septic system repair and replacement loans, and water quality testing.

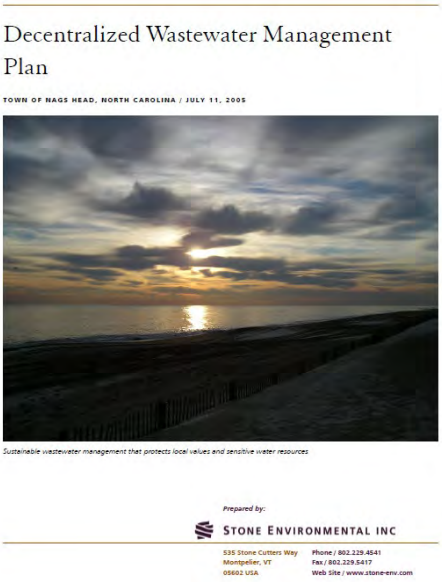
In 2005, the town developed a Decentralized Wastewater Management Plan and in 2022 the Town completed an update of the Plan.

1.1 Current Decentralized Wastewater Management Plan

In July of 2005, Stone Environmental, Inc. of Montpelier, Vermont conducted studies and published two reports; the Town of Nags Head Decentralized Wastewater Management Plan – Final Technical Report which described scientific analyses which formed the basis of the second report, the Town of Nags Head Decentralized Wastewater Management Plan (DWMP, pictured right). The DWMP identified recommendations for the management of onsite wastewater treatments systems. Many of the recommendations have been implemented and are discussed in further detail in other sections of this Plan.

The 2005 DWMP mission demonstrated Nags Head's commitment to effective septic system management, the environment, and public health. The mission stated:

> *The Town of Nags Head is committed to protecting the environment and public health. Effective care of onsite systems is essential to keeping this commitment. The town will enhance its oversight of these systems in a fair, reasonable, and cost-effective manner to ensure they are well managed and that system owners have the information and tools necessary to protect their private investment and the public good. The Decentralized Wastewater Management Plan will be dynamic and evolving over time so that decentralized systems remain a sustainable component of Nags Head's infrastructure.*



The 2005 DWMP Technical Report reviewed data related to water resources, septic system characteristics, and developed a database with parcels, onsite wastewater treatment systems (OWTS or septic systems), and water resources data. The Plan collected available data on water use, parcel size, and water quality in groundwater and surface waters. The report evaluated properties' environmental impacts by neighborhood and town-wide. Finally, it summarized their conclusions and recommendations, which informed the development of the second document, the DWMP.

The three key findings identified in the origional DWMP Technical Report were:

1. Older, substandard systems such as sand bottom tanks are impacting the environment, though not necessarily causing a surface failure through limited treatment and direct effluent contact with groundwater

2. Septic systems near shallow, seasonal high groundwater tables are impacting the environment by directly mixing partially treated effluent from the drain field with groundwater
3. Properties with high water use may be impacting the ability of the onsite systems to sufficiently treat the wastewater effluent

The adopted 2005 DWMP described recommended improvements and expansions to the original SHI. Below are the 10 recommendations/categories and status of implementation. Refer to the original DWMP to learn more about these recommendations.

1. Septic Tank Inspection and Tank Pumping Program – This is the main focus of the current SHI program, and the town is actively offering and conducting inspections, providing water bill rebates for septic system pump outs, and providing low-interest loans for repair and replacements
2. Permit Tracking and Reporting – The Dare County Department of Health, NC DEQ, and North Carolina Department of Health and Human Services (NC DHHS) manage the wastewater system permitting program, and the ability to collect and report this data has not occurred to date
3. Water Use Tracking and Reporting – Connecting water use vs. Wastewater design flows is a very difficult task and has not yet been available, even though this data is very important for analyzing wastewater treatment
4. Water Quality Monitoring Program – 28 sites are monitored regularly
5. Intensive Individual System Monitoring Study – *not implemented*
6. County Permit Data Collection – *not implemented*
7. Integrated Stormwater/Onsite System Analysis – *not implemented*
8. Overall Education and Outreach – The town has implemented several activities related to education and outreach
9. Zoning Regulation Changes – *not implemented*
10. Ongoing Analyses and Program Review – While a yearly analysis of water quality data has been conducted, this Plan is the first holistic view of all water quality data and the first formal comprehensive review of the program. The SHI was revised in 2019 and renamed to honor Todd D. Krafft and is formally called the Todd D. Krafft Septic Health Initiative.

The DWMP concluded with budget estimates for the proposed recommendations and a matrix relating the technical report conclusions to the proposed management plan options – the town's annual budget and the water fund allocate funds to implement the program.

1.2 The Problem

Nags Head's economy is greatly dependent on tourism, and the tourism in Nags Head centers around water recreation. Nags Head has been a beach resort town since the mid-1800s, has the longest oceanfront shoreline in Dare County, and is the gateway to the Cape Hatteras National Seashore. The year-round population is 3,175 but can rise to over 40,000 during peak summer periods, and water-based recreation at the beach and in other waters are by far the most popular activity for visitors and residents alike.

Ensuring the appropriate management of septic systems is critical for protecting water resources. The Town has grown significantly in recent decades and Town officials and residents have become increasingly concerned about the impacts of septic system failures. Septic systems are used by over 85% of Town properties. If these systems are substandard, inappropriately installed or maintained, or otherwise impaired, they can impact water quality in surface and groundwater, the sound, and the ocean.

The continued challenge with septic systems is that these systems are buried underground and are “out of sight and out of mind.” Many property owners are unaware of how to maintain the system and do not maintain them regularly; leading to failures, costly replacements, and wastewater directly entering groundwater and/or surface water. Because the systems are underground, it is hard to know when the system is having a problem. The most obvious indicators of a system failure are when wastewater is standing in a yard on top of the drain field or wastewater backs up into the house. In addition, homeowners often do not know if the system is effectively treating the waste or directly mixing with groundwater unless an inspection is conducted, or a subsurface water quality sample is collected and determined to have elevated levels of nitrate nitrogen. Failures both above and below ground can lead to untreated septic wastewater mixing with stormwater and groundwater. This can create water quality problems and bacteria exceedances impacting water resources in the town.

When a tank is not pumped regularly or the system is overused, excessive solids can collect in the tank and start to mix with the effluent water. Solids, nutrients, and bacteria-loaded effluent water then overflow into the drain field either causing a clog which can result in a backup of wastewater into a home, or failure of the drain field and wastewater coming to the surface. If a clog or backup does not occur, heavy loads of nutrient and bacteria effluent are pushed into the ground to filter. Long-term heavy loads of effluent may not be treated properly by soils as they become saturated. The partially treated effluent then mixes with groundwater or surface water causing poor water quality and high levels of bacteria. This problem can be avoided through routine maintenance, inspections, and pumping of septic tank systems.

The Town of Nags Head faces climate change conditions associated with sea level rise (SLR) and increasing rainfall totals which may affect onsite septic systems including groundwater table depths rising closer to the surface. High and rising groundwater tables can create little or no separation from the ground surface. These factors can greatly reduce filtration within the drain field for onsite septic systems and/or directly mix untreated effluent into groundwater sources. Additionally, water elevation changes due to SLR, King Tides, high intensity short duration rainfall, hurricanes, and nor’easters can also create excessive inland and coastal flooding. Low lying areas within Nags Head have greater potential for septic system failures due to rising groundwater tables and the effects of climate change. Some of the most vulnerable, lower lying areas include locations between the highways (NC 12 and US 158), along the soundside west of US 158, Old Nags Head Cove, properties adjacent to the causeway/US 64, and in South Nags Head. This is discussed in greater detail in Section 9.0 Future Conditions and Section 10.1 Septic System Site Evaluation Criteria and Risk Assessment under Existing Site Conditions.

1.3 The Solution

By proactively maintaining septic systems homeowners can improve the effluent treatment and lifecycle of residential onsite septic systems. The most effective activities a homeowner can conduct include an annual inspection, annual cleaning of the effluent tank filter, and pump out of the septic system tank every three to five years, depending on usage. Rental homes and homes with greater usage may need to pump out their septic systems on an annual basis due to more frequent use and high levels of occupancy beyond the design capacity.

The key to proactive septic system maintenance is education. Unfortunately, knowledge on this topic is not well discussed and many homeowners don’t know that something as simple as pumping out a septic system every three to five years could help avoid failures or costly replacement. From stakeholder interviews conducted for the Plan, David Swinney, Septic Inspector said, “Septic system maintenance is like changing a car’s oil. You know you need to change the oil every 3 months or 3,000 miles. Similarly,

for septic system maintenance, you need to pump the tank out every three to five years to maintain a functioning system otherwise wastewater is going to back up into your house."

For septic system maintenance, information may not be passed along to a homeowner when a home is purchased. Although strongly recommended, Dare County does not require a septic system inspection prior to the sale of a home, though some lending institutions may require one. Homeowners can obtain information on the location of their septic system from Dare County's Environmental Health Department. Records are currently in paper format and located in file cabinets that are not accessible via an online GIS platform. Specific recommendations for improving homeowner maintenance can be found in Section 7.0 Todd D. Krafft Septic Health Initiative Program Evaluation.

Additional education materials for those who may not have had a septic system previously will help educate new residents and owners on how to care for and maintain a system. Welcome packets to new homeowners regarding septic systems and water quality information along with educational materials would assist new residents and owners in understanding septic systems, links to water quality, and the SHI incentives and program value. Additionally, social media, EPA Septic Smart, and future Town of Nags Head public service announcement (PSA) septic system and water quality videos on YouTube are excellent resources that can be added to the program to further educate homeowners, renters, and visitors.

Currently, under the SHI, the town offers a free septic system inspection to determine if a homeowner's septic system is functioning properly. The resulting inspection report provides the homeowner with recommendations for maintenance including if the septic tank needs a pump out. The Town currentloffers a pump out rebate, via a water utility bill credit of $45, as well as low-interest loans to homeowners that need septic system repairs or replacement due to a failure.

Since the program's inception, collecting water quality and bacteria samples has provided the town with a great deal of data that is being used to identify problem areas where there may be concerns about the functionality of septic systems due to higher levels of nitrogen and phosphorus in surface water quality and increases in bacteria levels. Continuing to collect water quality samples will support the Town's effort to assist homeowners in maintaining properly functioning septic systems and alert the town to water quality concerns where additional study may be needed. The resulting information could be used to target neighborhoods for additional outreach, education, septic system inspections, and possible pump outs. Current data analysis of water quality parameters can be found in Section 7.4 Water Quality and Data Analysis.

As conditions change and systems age, septic system failures may become more frequent. The SHI Program is essential in ensuring the continued functionality of septic systems and excellent water quality in recreational waters. Setting higher programmatic goals with more frequent inspections, greater septic system pump out rebate incentives, and higher loan amounts for replacements will provide homeowners with resources to continue to utilize onsite septic systems in Nags Head as a means for wastewater treatment.

SECTION 2.0

Plan Update Process

2.0 Plan Update Process

This Plan combines the town's initial Decentralized Wastewater Management Plan and the Final Technical Report developed in 2005 into one document. The intent of this Plan is to evaluate the overall effectiveness of the 2005 Plan and the SHI program, recommend additional measures as necessary, and expand and integrate the 2005 Plan, considering the relationship between septic systems, stormwater, and groundwater.[1]

The Plan will be used by town staff, and elected leaders to strategically manage septic systems. Town staff will utilize the Plan and data analysis as a management tool to aid in improving the SHI and making management decisions related to septic systems to foster water quality improvement. Designers and developers may also use this Plan as a guide to supplement state and county regulations. Regulators, like those from NC Department of Health and Human Services Division of Public Health Environmental Health Section (NC DHHS EHS) and Dare County Environmental Health (DCEH) as well as surrounding communities, can utilize this Plan as a template to improve regional septic system education, outreach, and planning.

This Plan integrates changes that have occurred since the initial plan development in 2005, including regulatory revisions, and interconnection to other town services, plans, and programs. The Plan also analyzes the efforts under the SHI program including septic system inspections, septic system pump out credits to a homeowners' water utility bill, septic system repair and replacement loans, water quality sampling, and bacteria sampling. Additionally, the plan incorporates previous studies developed under a three-year UNC Capstone Report and a NCSU Tipping Points Project, and a new study being conducted by ECU Coastal Studies Institute (CSI) that is evaluating groundwater table elevations and subsurface water quality. Lastly, the Plan includes a section on future condition considerations and planning guidance that evaluates septic system risk based on current conditions. The Plan provides a list of prioritized recommendations and action items to further expand the program in the next five years.

2.1 Citizen Advisory Committee

In 2020, the Town of Nags Head called for applicants to serve on a citizens' advisory committee to provide guidance and feedback on DWMP updates. On November 4, 2020, four citizens were appointed to the newly formed Decentralized Wastewater Management Plan Advisory Committee. Members included Basil Belsches, Dave Herrmann, Bob Muller, and Bill Simmons.

The Plan's AC aided in identifying and engaging stakeholders, attending community meetings, providing recommendations to the SHI program, and providing feedback, draft reviews, and approval of recommendations to the Plan. The AC was engaged throughout the duration of the Plan development process and met once a month.

The AC specifically reviewed septic and regional studies related to homeowner perceptions of septic systems, SHI program analysis, data from the ECU CSI groundwater table elevation study, surface and subsurface water quality data evaluations, public education and outreach, and funding sources. The AC provided detailed programmatic and management recommendations and action items to the Plan and

[1] https://www.nagsheadnc.gov/1035/Decentralized-Wastewater-Management-Plan

SHI based on stakeholder interviews, community feedback, and data analysis. See Appendix A for additional information and details on the AC meetings.

2.2 Plan Tasks and Schedule

The Plan development team is comprised of Town of Nags Head staff; Town Manager Andy Garman, Planning and Development Director Kelly Wyatt, Principal Planner Holly White, AICP, CFM, Project Manager and Environmental Planner Kylie Shephard, Town Engineer David Ryan, PE, and Senior Environmental Planner Kate Jones. Consultant staff from Tetra Tech included Project Manager Holly Miller, PE, CFM, CPESC, Hillary Yonce, PH, Dr. Kateri Salk, Bobby Tucker, PE, Assistant Project Manager Mary Clark, Dr. A. Robert Rubin, A. Rubin and Associates, and Dr. Michael O'Driscoll and Charlie Pittman Humphrey of ECU CSI. Additional contributors include Katie Hill of University of Georgia and Vic D'Amato, PE of NC DEQ Division of Water Resources. Lastly, the Plan's Advisory Committee is comprised of four residents from the Town of Nags Head: Basil Belsches, Dave Herrmann, Bob Muller, and Bill Simmonds who contributed greatly to the development of the Plan.

The Plan development took thirteen (13) months to complete and included several tasks as outlined in the table below. Task 1 involved kick-off meetings and data collection. This task gathered background data from other studies and information from all of the SHI program incentives. Task 2 analyzed the SHI data, developed a data management framework to aid in organizing the data, and conducted stakeholder interviews. Task 3 involved taking data analysis and results from tasks 1 and 2 to develop new incentives and program goals. The team looked specifically at an expansion to the current DWMP with additional management plans, SHI program incentives, sources of funding, and obtaining feedback from the public with a public forum and community questionnaire. Lastly, task 4 developed draft Plan documents for team review and revision prior to finalization and approval by the Town of Nags Head Planning Board and Board of Commissioners.

Table 2-1**.** DWMP Tasks and Schedule

Task	Date
Task 1: Project Scoping and Data Collection	
Kickoff with Staff and Committee	03/01/2021
Community Engagement	03/30/2022
Develop Work Session Schedule	04/30/2021
Water Quality Data Collection	08/30/2021
Advisory Committee Meeting #1 - Kickoff	03/10/2021
Advisory Committee Meeting #2 - Communication Plan	04/15/2021
Task 2: Data Analysis and Synthesis	
Advisory Committee Meeting #3 - Communication and Perspectives	05/20/2021
Advisory Committee Meeting #4 - Advisory Committee Survey and Engagement	06/17/2021
Stakeholder & Staff Perspectives Work Sessions	08/17/2021
Advisory Committee Meeting #5 - Data Collection and Stakeholders	08/19/2021

Advisory Committee Meeting #6 - Data Analysis and Management	09/16/2021
Data Management & Access Work Session	09/30/2021
Water Quality & Infrastructure Assessment	09/30/2021
Working Synthesis Document	12/30/2021
Task 3: Management Planning	
Plan for Adoption, Funding, Data Management, Outreach & Implementation	10/01/2021
Advisory Committee Meeting #7 - SHI and Funding	10/21/2021
Board of Commissioners Presentation	11/03/2021
Public Forum	11/18/2021
Task 4: Plan Delivery	
Draft Plan, Feedback & Updates	
Rough Draft of Plan Outline	12/16/2021
Advisory Committee Meeting #8 - Draft, SHI, Vol. Subscription	12/16/2021
Draft Plan Development and Submittal	12/23/2021
Draft Plan Review #1 - Comments by Town	01/07/2022
Develop Advisory Committee Goal, Decisions, and To Do List	01/07/2022
Advisory Committee Meeting #9 - SHI Recommendations and VSSS Framework	01/13/2022
Draft Plan Review #1 - Comments by Advisory Committee	01/18/2022
Final Plan Revision Based on Comments	01/20/2022
Advisory Committee Meeting #10 - VSSS and Financials	01/20/2022
Final Draft Plan Review & Comments by Town and Advisory Committee	02/04/2022
Final Plan Delivery	
Planning Board Meeting Presentation and Draft Document Review	02/15/2022
Advisory Committee Meeting #11 (as needed)	02/17/2022
Agenda Item to Town Clerk	02/22/2022
Public Hearing and Board of Commissioners - First Reading	03/02/2022
Planning Board Meeting Recommendation	03/15/2022
Advisory Committee Meeting #12 (as needed)	03/17/2022
Board of Commissioners - Second Reading	04/06/2022
Decentralized Wastewater Management Plan Adoption	04/13/2022

A large component of the Plan engaged stakeholders and the community early in the process to determine what is working, what has changed since 2005, and what needs improvement. The SHI program was reviewed to quantify the annual SHI services provided to residents including septic system inspections, pump out rebates, septic system repair/replacement loans, and the overall value of the program to homeowners. Additionally, water quality and bacteria data that has been collected since 2005 was analyzed to determine program effectiveness. More detail on the water quality and bacteria analysis can be found in Section 7.0 Analysis of the Todd D. Kraft Septic Health Initiative Program Incentives and Section 7.4 Water Quality and Bacteria Data Analysis.

Groundwater table elevation and subsurface water quality data were collected by ECU CSI campus. Faculty collected groundwater elevation levels and subsurface water quality to measure and determine the depth of groundwater, quality of subsurface water, and potentially problematic areas of water quality where septic systems may not be functioning properly. This data was collected over a period of 11-months and provides insight into how groundwater tables are rising and impacting septic systems in the town as well as Dare County. Detailed information is located in Section 8.0 Groundwater and Subsurface Water Quality Data Analysis.

The Plan also briefly discusses septic impacts from future conditions due to the effects of climate change. Additional data, regional watershed models, and climate models may be needed to determine the effects of climate change in more detail for Nags Head. Future Conditions can be found under Section 9.0 Future Conditions.

Based on the data, a new section has been included in this Plan that introduces septic system planning guidance that develops evaluation criteria and risk assessment guide. Details and maps can be found in Section 10.0 Septic System Planning Guidance.

Lastly, the recommendations provided in this document strengthen the program to continue to provide incentives to homeowners to proactively maintain their septic systems and to increase awareness and education to homeowners, renters, and visitors on the connection between septic systems and water quality and long-term watershed health. The SHI programmatic recommendations can be found under Section 7.0 Todd D. Krafft Septic Health Initiative Program Evaluation, including several new incentives including future programmatic framework, a voluntary septic subscription service, and additional public education and outreach.

SECTION 3.0

Community And Stakeholder Engagement

3.0 Community and Stakeholder Engagement

In addition to extensive stakeholder engagement through interviews and surveys during the Plan process, several documents were reviewed to assist in understanding community and stakeholder perceptions of the program. The three-year UNC Capstone Reports and NCSU Tipping Points Project offered significant insight into community and regional perceptions of septic systems. Links to these reports can be found in Appendix F - Resources and References.

For the Plan, nineteen (19) key community stakeholders were interviewed to understand stakeholder perceptions of the program and obtain suggestions or recommendations for the future of the program.

Lastly, the community was provided a questionnaire and a public forum was held to provide the data analysis and solicit feedback on SHI program improvement recommendations.

Additional details, interview take aways, questionnaires, and polls can be found in Appendix B.

3.1 Partnerships and Collaborations

To strengthen the Plan, the town will need to continue to enhance existing partnerships and collaborations and build new relationships with regulators, stakeholders, and community groups, including but not limited to: Dare County Environmental Health, NC Department of Environmental Quality, NC DHHS EHS, Cape Hatteras National Seashore and National Park Services, Jennette's Pier and NC Aquarium, Jockey's Ridge and State Park Service, Albemarle-Pamlico National Estuarine Partnership (APNEP), Nags Head Woods and The Nature Conservancy (TNC), ECU CSI, UNC at Chapel Hill Institute for the Environment Coastal Studies Institute (UNC-CSI), National Ocean and Atmospheric Administration (NOAA), NC Coastal Federation, NC Sea Grant, Outer Banks Association of Realtors, rental agencies/property management companies, septic tank pumpers and inspectors, engineers/soil scientists, Outer Banks Home Builders, and Nags Head HOAs.

Partnerships can aid in funding and support for programmatic elements, further studies, or installation projects directly related to non-point source pollution or septic systems. Additionally, partnerships can aid in education and outreach regarding the dissemination of information related to the SHI program incentives, septic system maintenance, and the connection between septic system failure and water quality.

3.2 Related Studies and Reports

Over the last few years, the town has partnered with both the University of North Carolina Field Site at CSI and the North Carolina Sea Grant to participate in important research that investigates areas of programmatic concern and further supports the growth of the SHI Program. The research aims to understand septic function, management, regulation of systems, and risks of septic wastewater contamination of surface and groundwater. While these studies contain ecological aspects related to water quality, they also examine community perspectives of both citizens and onsite wastewater system professionals. The three-year UNC Capstone reports and Sea Grant funded Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas research project offered significant insight into

the community and regional perception of septic.[2] In depth studies lead by ECU CSI, as part of the Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas research, looked at groundwater table elevations and subsurface water quality. A portion of the study results is detailed in Section 8.0 – Groundwater and Subsurface Water Quality.

The UNC Capstone Reports consist of three, separate septic system and water quality projects from 2018, 2019, and 2020. The studies outlined the challenges of onsite septic systems in a coastal community as well as the communities' perspective on how septic relates to water quality. These reports were the basis for the stakeholder interview discussions as SHI recommendations.

A. "**What Lies Beneath: Septic Systems and Water Quality in Nags Head, NC**" UNC Capstone Report (3rd Year of Study) was completed in the Fall of 2020 and studied the Gallery Row sub watershed area of town. Below is an excerpt from the report.

   "There were several takeaways from the human dimensions aspect of this study. Survey respondents indicated high risk perceptions regarding septic systems, which correlates with the findings that groundwater contamination from septic systems is a problem in Nags Head. However, there are variations in knowledge regarding septic information among survey respondents. Those who claimed to be knowledgeable were more likely to have their tanks pumped regularly, indicating that engaging and educating property owners about septic maintenance could encourage positive behavior in the future. Most respondents believe the Town of Nags Head has a responsibility to provide information on septic systems. If the town would like to increase outreach and property owners' access to information, survey respondents expressed they would prefer to receive information in the form of electronic newsletters from the town, the Town of Nags Head website, the Dare County Health Department website, and videos/webinars produced by the Town of Nags Head."[3]

B. "**People, Water and Septic: A Coastal Case Study**" UNC Capstone Report (2nd Year of Study) was completed in the fall of 2019[4]. Below is an excerpt from the report.

   "When gauging risk perceptions, we found that in line with our hypothesis, three stakeholder groups (public officials, researchers, and septic professionals) perceive a high risk of contamination of groundwater from poorly maintained septic systems. Property owners, however, perceive a risk of the sound and the ocean being contaminated, and did not typically address septic interactions. More awareness of groundwater-wastewater-surface water contamination could be raised through outreach and would likely be successful in mitigating the issue because of people's deep connections to this area and their awareness of many environmental changes that are already occurring, making them more motivated to change personal behaviors. Because of the limitations of this study, more research into the interactions between wastewater, groundwater, and surface water in Nags Head is warranted. There are many improvements to data collection that could be made to the study in the next year to increase the accuracy and

[2] https://www.nagsheadnc.gov/935/Long-Range-Planning

[3] What Lies Beneath: Septic Systems and Water Quality in Nags Head, NC, UNC Capstone Report (3rd Year of Study), Fall 2020

[4] Fall 2019 "People, Water and Septic: A Coastal Case Study" UNC Capstone Report (2nd Year of Study)

connectivity of the study's conclusions. For bacterial analyses, sampling the same wells for water quality, identifying additional indicators of bacterial origin in wastewater, and looking at water use records will help explore connections between localized and seasonal water use and groundwater-wastewater-surface water interactions. Mining for data on septic system age, type, and inspection history will improve our understanding of the relationship between septic systems and their effects on the hydrologic cycle. Next year's study could further explore the hydro social cycle through a sociological lens by looking into how the considerably larger seasonal population of Nags Head can be educated about groundwater-wastewater-surface water interactions.

The findings of our study indicate that Nags Head would benefit from more action by both individuals and decision makers for the town to ameliorate issues arising from groundwater-wastewater-surface water interactions. More research into these interactions is warranted so that the temporal and spatial limitations of our study can be minimized. Our study helped to demonstrate the risk of these interactions through GIS analysis to determine if the town's recent actions, including the SHI and the recent groundwater table lowering, have been successful. Our findings indicate that the groundwater lowering may have been successful in improving water quality in the at-risk areas, but more research and connectivity is needed to strengthen these conclusions. More outreach and education for the general public and seasonal residents of the town is warranted in order to increase the general knowledge level of the public's perception on wastewater risk. The three-episode podcast Flushed: A Potty Talk Podcast, which was produced concurrently with this report and uses the study's findings, would be an effective tool to use in this outreach."[5]

C. "**Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity**" UNC Capstone Report (1st Year of Study) was completed in fall 2018[6]. Below is an excerpt from the report.

"Conclusions and Implications: The home- and business-owners in and around the Gallery Row sub-watershed that we interviewed value Nags Head and the Outer Banks for a variety of reasons. A combination of connections to water, community, and resiliency revealed a strong sense of place among participants. These attachments to place and water and associated knowledge and experience positioned our participants to make observations of the community's vulnerabilities to environmental stressors. Participants cited increased storms, flooding, and climate change as drivers of concerning changes to water quality and quantity. These concerns translated into perceptions of risk of septic leachate, septic tank failure, and ultimately worsening of water quality. Although participants acknowledge these issues with current wastewater treatment systems, they expressed hesitation over centralized wastewater treatment citing costs, feasibility, lack of knowledge, and density development as barriers to change. Noting the tradeoffs between treatment methods and fear of large-scale change, the negatives associated with centralized treatment outweighed the current risks associated with septic systems for our participants. Addressing the perceived risks was thought to be the responsibility of the Town of

[6] Fall 2018 "Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity" UNC Capstone Report (1st Year of Study)

Nags Head even though participants did note how they as individuals may improve their own wastewater treatment systems. These findings improve our understanding of how participants' value water quality, responsibility, and adaptation in Nags Head. These perceptions may impact future decision-making in Nags Head regarding wastewater treatment and environmental management policies."

Conclusions on perceptions: "Analysis of our semi-structured interviews revealed that participants are attached to the waters of Nags Head for a myriad of reasons including aesthetic value and uniqueness, as well as for tangible benefits like recreation. Many of them believed that not only were the waters and other environmental conditions changing, but the changes were also being exacerbated by a combination of poorly managed stormwater and tourist-driven economic development that is resulting in increased flooding and decreased water quality. While many participants mentioned a broad variety of flood mitigation methods, they expressed a shared sentiment that there 'was only so much that one can do' to mitigate flooding. They lacked a reliable source of information about septic system maintenance, methods of wastewater treatment beyond septic, and quantitative measures of water quality. In general, septic systems as a wastewater treatment method were preferred over centralized sewage for several reasons including concerns about the expense and feasibility of installation and maintenance. After analyzing the interviews, the citizens of Nags Head could benefit greatly from a central repository of information on wastewater treatment, flooding incidence and water quality that could better prepare the public for future flooding events and increasing climatic variability. A lot of participants acknowledged that they were in Nags Head because of the water, but on the other hand were reluctant to spend money on fixing the problems of flooding and water quality. Existing efforts like the Septic Health Initiative currently managed by the Town of Nags Head are a step in the right direction, but they do not seem to be effectively communicating that flooding and water quality problems are ones that the townspeople are going to have to make decisions about very soon and that the decisions will not be without cost."[7]

D. The 2021 NC Sea Grant-led research "**Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas**" produced interviews with 20 septic installers and eight health regulators from North and South Carolina. Below is a summary of the interviewees' perceptions obtained from the report.[8]

    a. Health regulators evaluate sites for onsite wastewater systems with a snapshot, and do not consider seasonal weather or future climate changes.

        i. Inspections of a conventional septic system site are required prior to installation and are only monitored later if a formal complaint is made.

        ii. Engineered/advanced systems require regular inspections.

    b. Communication about septic system maintenance with homeowners is limited and inconsistent. Some information is communicated upon installation and after that it

[7] Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity, UNC Capstone Report (1st Year of Study), Fall 2018

[8] Vorhees, L. and J. Harrison. 2021. Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas: Perspectives from Wastewater Managers. North Carolina Sea Grant UNC-SG-21-06.

varies. Property owners generally have to seek out information from an educational website managed by a health department, local municipality, or university.

d. Some realtors and local health departments provide septic system information for the property.

e. 12% of interviewees said systems will fail if soils are dry and there is heavy rain.

f. 58% of interviewees said systems will fail if soils are wet and there is heavy rain.

g. 76% of interviewees said systems will fail if there are wet soils and king tide.

h. Positive drainage is the most important variable for long-term septic functionality, followed by soil type and elevation.

i. 65% of installers interviewed are preemptively taking action to adapt systems to extreme weather events.

Figure 3-1. Septic installers and pumper interviews as part of the NCSU Tipping Points Project

In summary, the documents revealed that the overall perception of the DWMP and SHI are an asset to the town, bring value to citizens, and should be continued. Below are key observations and recommendations from the documents that have been included in the Plan.

a. The Fall 2021 UNC Capstone Report, “What Lies Beneath: Septic Systems and Water Quality in Nags Head, NC” recommended that the town needs to do more in the way of education and that homeowners prefer obtaining information via electronic newsletters, town website, Dare County, and town YouTube videos.

b. The Fall 2019 UNC Capstone Report, “People, Water and Septic: A Coastal Case Study” indicated that Nags Head would benefit from more action by both individuals and decision makers for the town to ameliorate issues arising from groundwater-wastewater-surface water interactions. Additionally, more outreach and education for the general public and seasonal residents of the town is warranted to increase the general knowledge level of the public’s perception of wastewater risk.

c. The Fall 2018 UNC Capstone Report “Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity” noted that increased storms, flooding, and climate change as drivers of concerning changes to water quality and quantity. These concerns translated into perceptions of risk of septic leachate, septic tank failure, and ultimately worsening of water quality. Although participants acknowledge these issues with

current wastewater treatment systems, they expressed hesitation over centralized wastewater treatment citing costs, feasibility, lack of knowledge, and density development as barriers to change.

A recommendation from this report was that the citizens of Nags Head could benefit greatly from a central repository of information on wastewater treatment, flooding incidence, and water quality that could better prepare the public for future flooding events and increasing climatic variability.

d. The 2021 Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas Research: Septic Climate Interviews identified that communication with homeowners is limited and inconsistent. Information communicated upon installation and after that varies. Information is not provided directly to homeowners. Usually found on a website for maintenance and post flooding. 58% said systems will fail if wet soils and heavy rain and 76% said systems will fail if both wet soils and king tides were present. Installers are seeing 65% of homeowners installing adaptive measures.

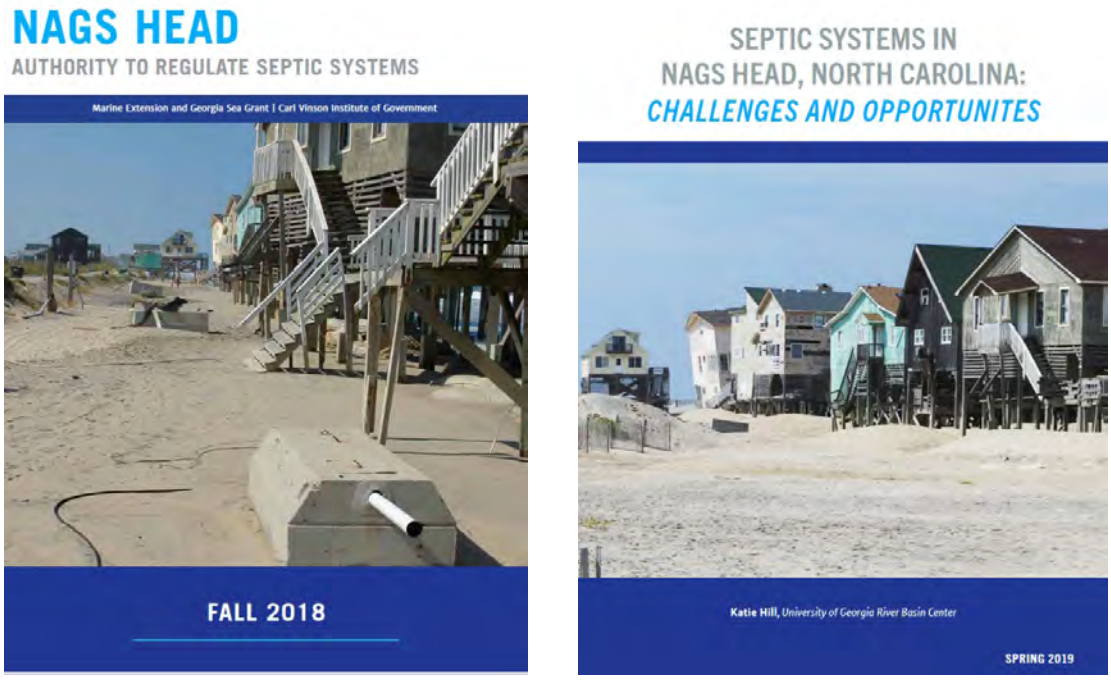


Figure 3-2. Partnerships with others like Katie Hill of UGA, have led to Nags Head septic studies and reports

Overall, these documents provide the town with valuable information on perceptions of the current DWMP and SHI. The recommendations outlined in these efforts have been included in the Plan.

3.3 Stakeholder Interviews

Stakeholder interviews were conducted with nineteen (19) key groups to further expand upon the UNC Capstone Report and Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas Research results and recommendations. The interviews took place over several weeks and revealed the DWMP and SHI programmatic strengths and provided recommendations for areas of improvement and expansion. Interviewees provided excellent recommendations that were utilized as the

basis for many of the recommendations outlined in the Plan. See Section 7.0 Todd D. Krafft Septic Health Initiative Program Evaluation for further program expansion recommendations and Section 12.1 Prioritization of Recommendations for Prioritization of Recommendations. Additionally, the interview notes and a key stakeholder interview takeaway summary can be found in Appendix B Public Communication and Stakeholder Engagement.

Stakeholders included local businesses, rental/property management agencies, realtors, environmental and recreational user groups, home builders, soil scientists, and septic inspectors. In addition, interviews were conducted with several Town of Nags Head Commissioners, Town of Nags Head Planning Board, town staff, Dare County Environmental Health, NC Department of Health and Human Services, NC Department of Environmental Quality, and the Town of Duck.

Overall, the DWMP and SHI are largely supported by the community. Several key takeaways and recommendations were generated through the stakeholder interviews.

Stakeholders commented that public education for new and existing homeowners and visitors/vacation home renters are still needed. Many people admitted they do not think about septic systems because they are out of sight and out of mind or have never utilized a septic system for wastewater treatment.

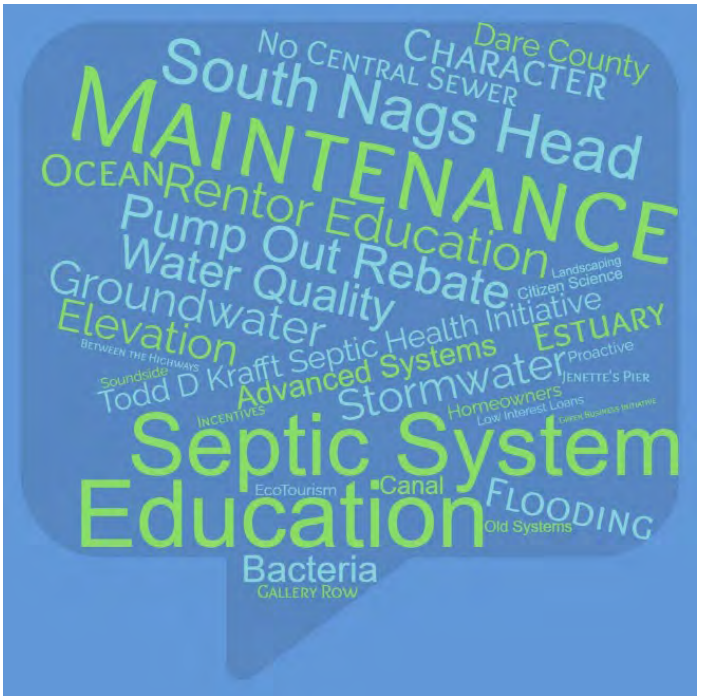


Figure 3-3. Word cloud summary of stakeholder interviews

Public education and outreach to homeowners is recommended. Ideas to increase education include more resources on the town webpage, social media posts, septic 101 educational videos of a tank location, pump out, filter cleaning, and plumbing repairs, and free giveaways or informational packets to new homeowners. Staff from Jennette's Pier, Jockey's Ridge, and Cape Hatteras National Seashore were interested in integrating septic and water quality education into their programs with hands on water quality sampling.

Giveaways and welcome packets may aid in promoting proactive and proper septic system maintenance. Giveaways and packets could include items like window clings of what not to put down the toilet, toilet flappers to reduce leaky toilets, shower/toothbrush timers to reduce water usage, postcards and flyers about the SHI, and grease can lids.

Additional program education recommendations included shifting the town's timing of septic system inspections and pump outs to be in the offseason (fall/winter for inspections and early spring for pump outs). To focus on education for hotspots or failing areas based on data, develop location education and training for engineers and soil scientists who are designing systems, and develop a water-themed

environmental fair at Dowdy Park in conjunction with World Water Day[9] in March, Earth Day in April, Eastern Surfing Association's Mid-Atlantic Regional Surfing Championship[10], American Public Works Association (APWA) Public Works Week[11] in May, or US EPA's SepticSmart Week[12] in September. The fair could feature various exhibits and hands on models of septic tanks, water quality sampling, water usage information, free giveaways, and educational materials.

Stakeholders noted that there is an overall lack of ease when trying to find septic system tanks and systems. The septic tank lids can be difficult to find due to changing conditions (sand) and homeowners installing landscaping or hardscapes over the tank. With sand build up septic system tank risers that were once six inches below the surface at installation can become buried with several feet of sand.

> *"I wish others would follow Nags Head's lead in being proactive when it comes to Septic Maintenance, Stormwater, and Water Quality."*
>
> **- Rob Crawford,** Senior Environmental Health Specialist, Dare County Environmental Health Services

Dare County Septic Permit records are not easily obtained and are largely in paper file format (some minimal information is available post-2005 online). When a homeowner or realtor calls to obtain a plat or permit record for a septic system Dare County prioritizes pulling old permits last, due to capacity. Currently, Dare County does not have an online database for septic system permits or plats/location of systems prior to 2005 and the estimated cost to scan and covert all the permits digitally is approximately $150,000. A recommendation of stakeholders was to provide locations of septic systems, plat maps, easements, better marking, and an online location GIS map. Stakeholders also recommended the town develop septic system drain field diagrams that include no parking regulations over the tank and drain field and an approved planting list with spacing to the system.

Water over usage and leaking toilets can cause septic system failure. A leaking toilet can use as much as 100 gallons an hour. Giveaways like toilet flappers and water usage education flyers that show how much money and water a homeowner can save by conserving water and fixing leaky toilets was suggested. A town educational video on how to install a toilet flapper valve would be a great way to promote water use reduction and proactive septic system maintenance.

Stakeholders also recommended developing green business initiatives. A new program could be developed to provide businesses incentives to protect the environment and water quality. While the current SHI does not provide incentives for businesses, this could be an avenue for the town to expand the program to have a wider reach to allow businesses to be involved in promoting septic system health and improvements to water quality. The program could also allow for additional education for citizens and visitors. John Harris, owner of Kitty Hawk Kites, discussed including water quality testing while on dolphin tours. Businesses that join the program could have designations with leaves or shades of green based on an environmental quality green business level designated by the town. Window clings, or stickers could be posted at the door showing their level. For example, green leaf level 1 could be a basic eco-conscious

[9] World Water Day

[10] Eastern Surfing Association Mid-Atlantic Surfing Championship

[11] APWA Public Work Week

[12] US EPA's SepticSmart Week

(entry-level), green leaf level 2 could be more eco-friendly (mid-level), and green leaf level 3 could be the eco-warrior (top-level). In addition, an annual water droplet/eco-tourism/eco-friendly award could be created for participants to recognize businesses for their environmental efforts.

Septic failures, groundwater elevations, and water quality were a big concern for stakeholders. Several stakeholders discussed that older systems were designed properly for conditions when installed but are now experiencing groundwater infiltration into the drain field. Flooding the drain field can cause water to back up into the tank and home and there is little to no filtration effluent. While the higher groundwater table does not cause a system to fail, there is little to no filtration of effluent that could result in impacts on water quality. Others noted that some older homes, on the soundside, may still have open sand bottom tanks that could be failing. Also, it was noted that systems are not seeing a failure on the surface because the difference in elevation of the home to the tank naturally pushes the water out of the tank into the drain field. The tipping point is when sewage backs up into the house and/or when the effluent rises to the surface in the backyard. So, septic systems could be operating, but may not be treating the effluent effectively, if at all. Some stakeholders noted that they were concerned about the water quality primarily in the sound due to increased nutrients after a rainfall and in the wetlands located along Cape Hatteras National Seashore.

During the interview process, many stakeholders commented on rental homes and their overuse. Many rentals are overbooked with large groups. As we know from regulations and septic design, many existing septic systems are not designed based on rental occupancy but rather on the number of bedrooms. This may be something that will need to be considered by Dare County under 15A NCAC 18A .1900 regulations during design that an additional capacity of 60 gallons per day may need to be designed into a septic system based on occupancy as a way to offset over occupancy. This could be a revision under 15A NCAC 18A .1900, within town building code standards, and through Dare County Environmental Health during the permit stage.

As a result of the interviews, it was determined that many property managers and rental agencies have clauses for owners to ensure annual septic tank pumping. Rental homes may need to be pumped out more frequently due to capacity and usage. As part of this Plan, increased guidance and education for rentals with higher occupancy or over occupancy (annual inspection, pump, and bigger/advanced systems) should be addressed. It was also noted that large houses are using/installing advanced pretreatment or advanced treatment units (ATU) with smaller drain fields that require contracted operators to inspect and maintain the systems frequently. While these systems are more efficient and compact, the smaller three and four-bedroom single-family homes will likely not be able to afford an ATU with a mounded drain field that can cost between $40,000 to $50,000.

During the stakeholder interviews, one question was asked regarding future conditions and alternative solutions. Generally, there was no support for centralized wastewater and sewer. Stakeholders believed that this could create increased development with smaller lot sizes that will affect the town’s character and impact the quality of life. Stakeholders did discuss alternative solutions. Decentralized cluster systems may be needed for failing septic systems due to high groundwater tables. Clustered decentralized wastewater treatment within neighborhoods/blocks of homes would be a good option if locations on individual parcels are no longer viable. South Nags Head and areas along the soundside have higher groundwater tables than oceanside and these maybe target areas for this type of treatment. Raised beds are another option but can compound stormwater runoff and flooding issues on neighboring properties that don’t have a raised bed. Advanced pre-treatment and advanced systems are expensive but may be needed in areas that are challenging or have limited area for a repair field.

Wastewater reuse and recirculation pumps septic to one location, treats the effluent, and then recirculates it back to the homeowner's tank and drain field and would be a good way to remove pollutants. The process would keep existing onsite infrastructure and return as grey water for reuse, irrigation, or groundwater recharge. Grey water reuse/recycling recirculates treated wastewater back into toilets or can be used for irrigation. While this technology is not widely used in Nags Head, it would save water and reduce water bills as well as limit excess water entering shallow water aquifers. Decentralized wastewater treatment that cleans septic and then recirculates it back to the homeowner's tank and drain field would be a good way to remove pollutants. Easements would need to be recorded on plat maps to utilize this type of approach. The process would keep existing onsite infrastructure and return as grey water for reuse, irrigation, or groundwater recharge. Old Nags Head Cove would be a good location for this due to the canals. Alternatively, advanced treatment or drip distribution would help with pretreatment to create more efficient septic treatment systems.

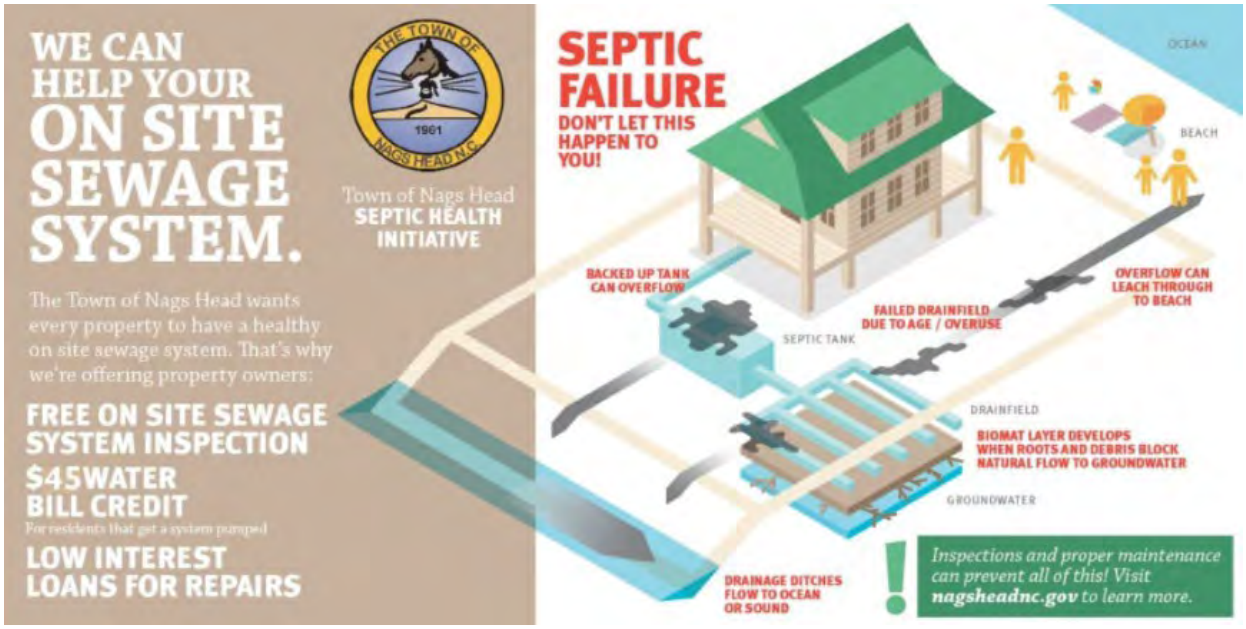


Figure 3-4. Current DWMP Town SHI Educational Flyer

Stakeholders noted that stormwater inundation and flooding can have big impacts on septic systems. Stakeholders recommended treating pollution at the source can help filter pollutants by adding single-family home rain gardens to capture and infiltrate roof runoff from downspouts and by adding green stormwater infrastructure (GSI) and low impact development (LID) techniques to help filter pollutants prior to entering outfall or the sound/estuary. Care needs to be taken not to place GSI or LID measures near the septic drain field. Overall stakeholders would like to see more nature-based solutions that mimic Nags Head natural systems, decrease impervious surface, and that increase groundwater infiltration/aquifer recharge. Stakeholders also discussed that there is higher groundwater during the rainy season and stormwater management is good at containing/managing stormwater. The groundwater lowering projects have made a big, positive impact on groundwater levels. Overall, Nags Head is ahead of the game compared to others in Dare County.

Stakeholders noted that the SHI program is well supported. Dare County specifically wished others would follow the Town of Nags Head lead in being proactive. Single-family, year-round residents that may not have a lot of disposable income benefit greatly from the program. Recommendations to the SHI included the addition of a Voluntary Septic System Service Subscription that would provide added benefits above

the SHI, a grant program to aid in replacements of a failed system, and possible conversion of conventional septic systems to a more advanced treatment system, increased dollar amounts for pump out rebates ($150), and higher loan amounts to accommodate additional fill ($12,000) and/or advanced systems.

3.4 Community Questionnaire Survey Results

A nineteen-question (19) survey was provided to the community via Microsoft Forms to obtain feedback on the DWMP and SHI. The questionnaire asked participants about septic system maintenance frequency, concerns about system reliability, and if they knew about the SHI. The questions also asked about knowledge of septic system function and correlation to water quality.

The purpose of the questionnaire was to gain insight from the community regarding the Town of Nags Head DWMP and SHI program. The responses to this questionnaire were be used as a guide to inform what additional incentives and programs should be added, revised, and/or removed under the SHI.

The questionnaire obtained seventy-one (71) participants and a summary of the responses is provided below. Most respondents were either full-time residents or second homeowners that rent out their homes when not in use. The full questionnaire responses are included in Appendix B Public Communication and Stakeholder Engagement.

1. Of the 71 respondents, two-thirds of them were very or semi-familiar with the program. The remaining one-third did not know about the program.
2. The majority of respondents received information about the SHI either via flyer, town webpage, or Nags Head Lines. Many also answered that they are new to the town or had not yet received information.
3. When asked if they have used any services under the SHI, 29 responded as having used the inspection program, 18 used the pump out rebate, and 1 had used a low-interest loan. Additionally, 35 had not used the program or it did not apply to their treatment system.
4. Respondents were asked if the program was beneficial to improve and increase septic maintenance. Overwhelmingly respondents answered yes, while a small handful answered maybe or not applicable.
5. When asked if there were barriers to utilizing incentives under the SHI program, respondents answered primarily that they didn't know about the program, didn't know the inspections were free, and that the process for obtaining a pump out credit was unknown.
6. When asked what additional or increased incentives would motivate you to participate in the SHI program, the highest responses were increase septic pump out rebate and provide a voluntary septic system subscription program.
7. Respondents recalled they used a set number of years to indicate when they need to pump their system.
8. In general, the respondents knew that a septic tank needed to be pumped out every two, three, or five years.
9. When asked what additional education and outreach programs would better help you understand septic systems the top three responses were; provide guidance on best practices for inspections and maintenance frequency, provide a welcome packet to new residents/homeowners with septic information/giveaways, and provide information on what can be planted on or near septic systems.

10. The best way to reach respondents was by providing postcard flyers and mailers, providing an opportunity to join a septic email list-serve where information is provided directly to participants, and additional information provided on the town webpage.
11. Overall, the respondents agreed that septic system failures affect water quality.
12. The respondents thought that the town's water quality on a scale of 0 (poor) to 5 (excellent) ranked a 3.91, or good/above average.
13. They felt like many factors affect water quality
14/15. Respondents would like to see additional opportunities for education and outreach:
    a. Provide education/information that related septic health/maintenance to water quality
    b. Provide a map of water quality sample sites showing the health of the town's surface waters, sound, and ocean
    c. Provide water quality sample results on the town's webpage and what the results mean
    d. Provide a watershed report card detailing the health of the watersheds
16. When asked what additional improvements they would like to see the program expanded to multi-family homes and small businesses. They would also like to see the town conduct more samples in areas of environmental need or poor water quality, add additional outreach and education, and conduct small stormwater projects to aid in water quality improvement to treat stormwater.
17. Overwhelmingly respondents would like to see a voluntary septic system subscription service to assist.
18. Participants indicated that the benefits of a subscription service they were most interested in included:
    a. Yearly inspection
    b. Coordination of pump outs
    c. Post pumping inspection
    d. Notification of potential problems
    e. Greater discount on pump out rebates
19. Respondents were also asked about environmental factors that may impact their septic systems and what impact rising groundwater tables, more frequent high intensity rainfall events, and more frequent hurricanes have on septic system function. The responses included increases in septic system failure, increased need for septic system alternative and advanced systems, and the need for off-site small or large community decentralized wastewater systems.

3.5 Public Forum

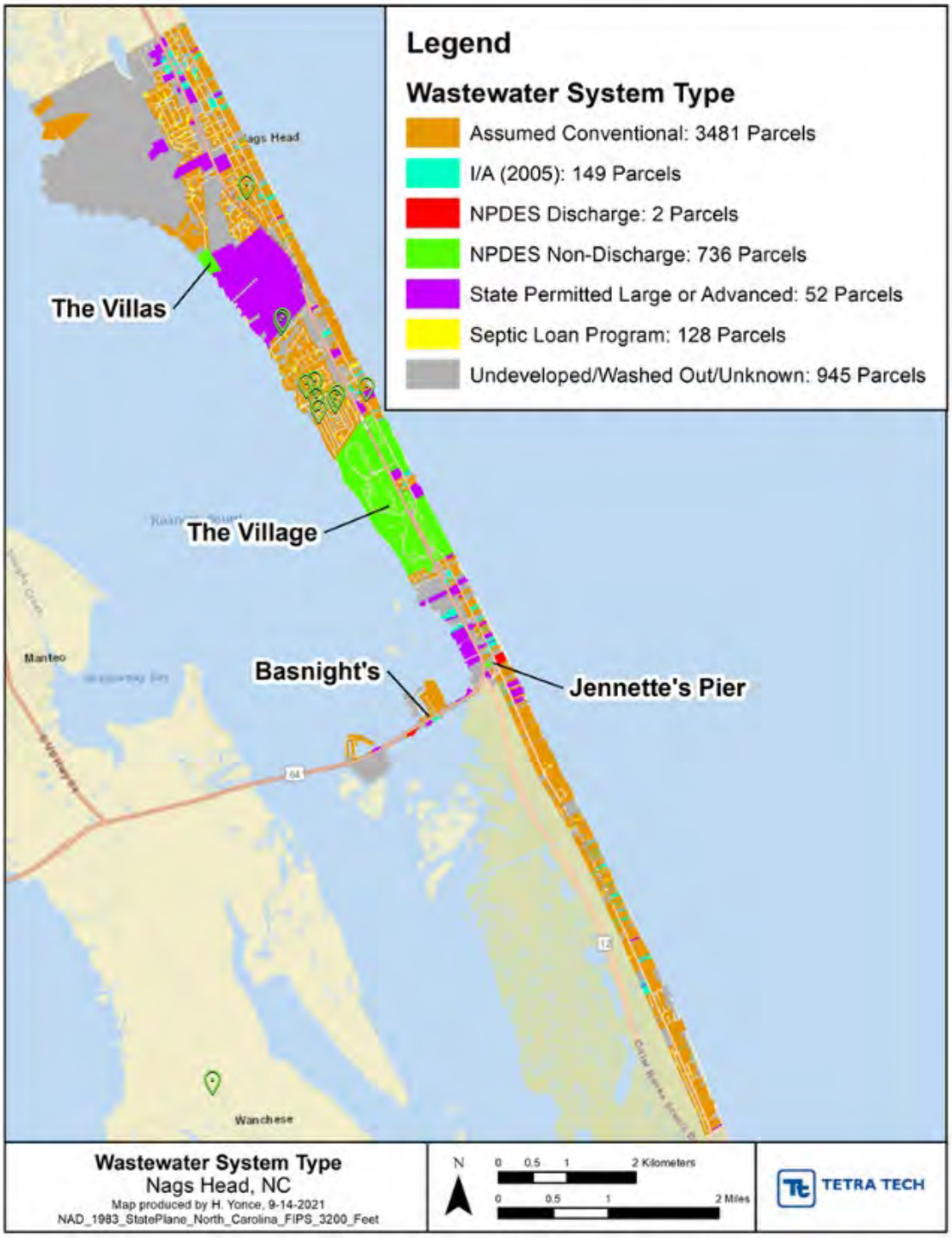
A virtual Public Forum was held on November 18, 2021, via Zoom. The forum provided a summary of the Plan status, the proposed recommendations, and provided an opportunity for septic system education.

To increase forum participation, eight (8) live poll questions were posed to the participants with similar questions outlined in the community questionnaire. The poll questions helped determine septic system understanding, concerns, and maintenance frequency during the forum.

Below is a summary of the poll questions.

Question 1: Approximately where do you live or where is your home in Nags Head?

Pinned responses (📍) included northern Nags Head, soundside, and south Nags Head.

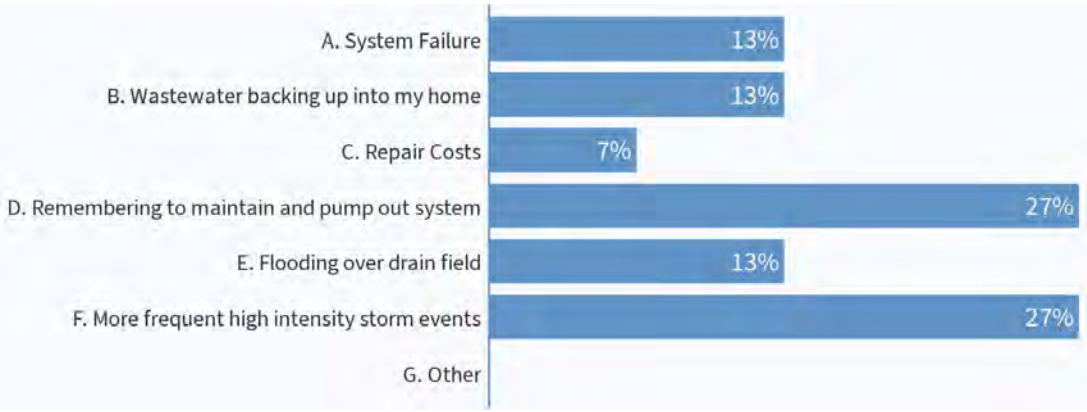


Question 2: How has your septic system been functioning in the last three to five years?

Reponses included words like good, great, works well, newer, and problems.

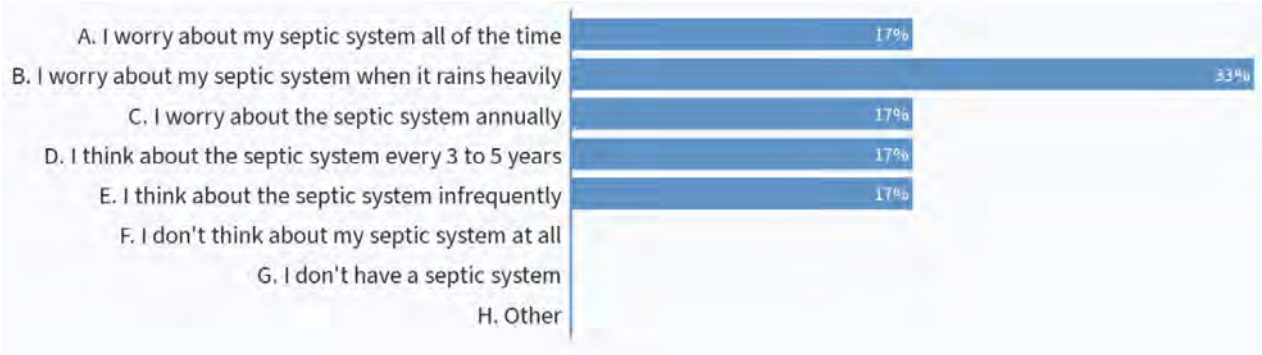
Question 3: What are your concerns about your septic system?

27% of responses included remembering to pump out system and more frequent high intensity storm events, and 13% included system failures, wastewater backing up into my home, and flooding over the drain field.



Question 4: Are there certain times when you are worried about your septic system failing and how frequently?

33% of responses said I worry about my septic system when it rains heavily. The remaining respondents said, I worry about my septic system all the time, I worry about my septic system annually, every three to five years, and I think about my septic system infrequently.



Question 5: What activities do you conduct to ensure your septic system is functioning properly?

Responses included words like inspect, look/watch, sniff, pump, flush, get a contractor, and communicate.

Question 6: What do you think the most pressing issues are related to septic system function and management?

Respondents said the most pressing issues were groundwater elevations getting closer to the surface and septic failures affecting stormwater, surface water, sound, and ocean water quality. They also noted sea level rise is exacerbating increasing conditions creating threats to septic systems and that proper septic system function and long-term maintenance are needed.

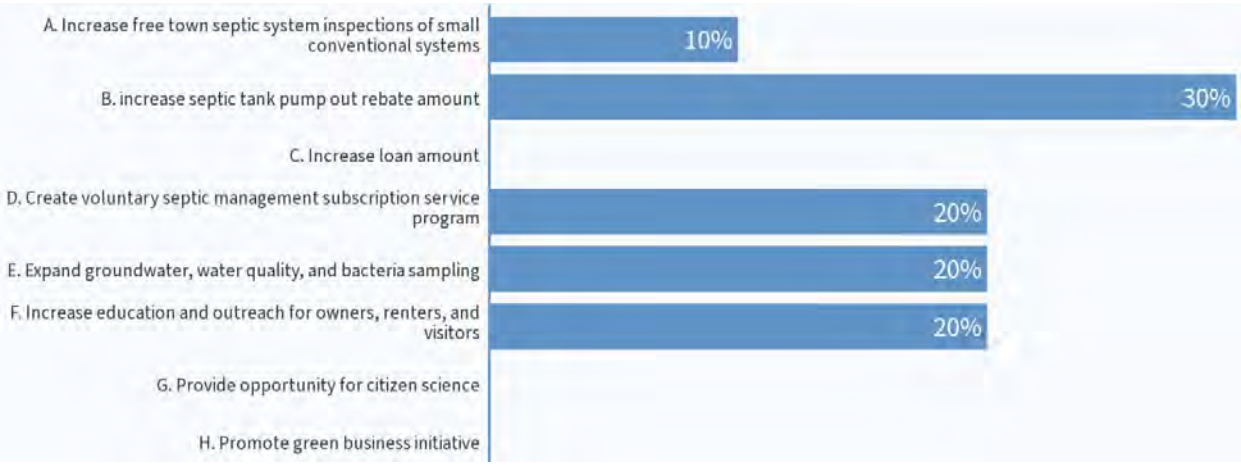
Question 7: Pick your top three revisions/additions to the SHI.

#1: Respondents picked increased septic tank pump out rebate (30%)

#2: There was a three-way tie at 20% each for:

a. Create voluntary septic system subscription service
b. Expand groundwater, water quality, and bacteria sampling
c. Increase education and outreach for owners, renters, and visitors

#3. Increase free town septic system inspection of small conventional systems (10%)

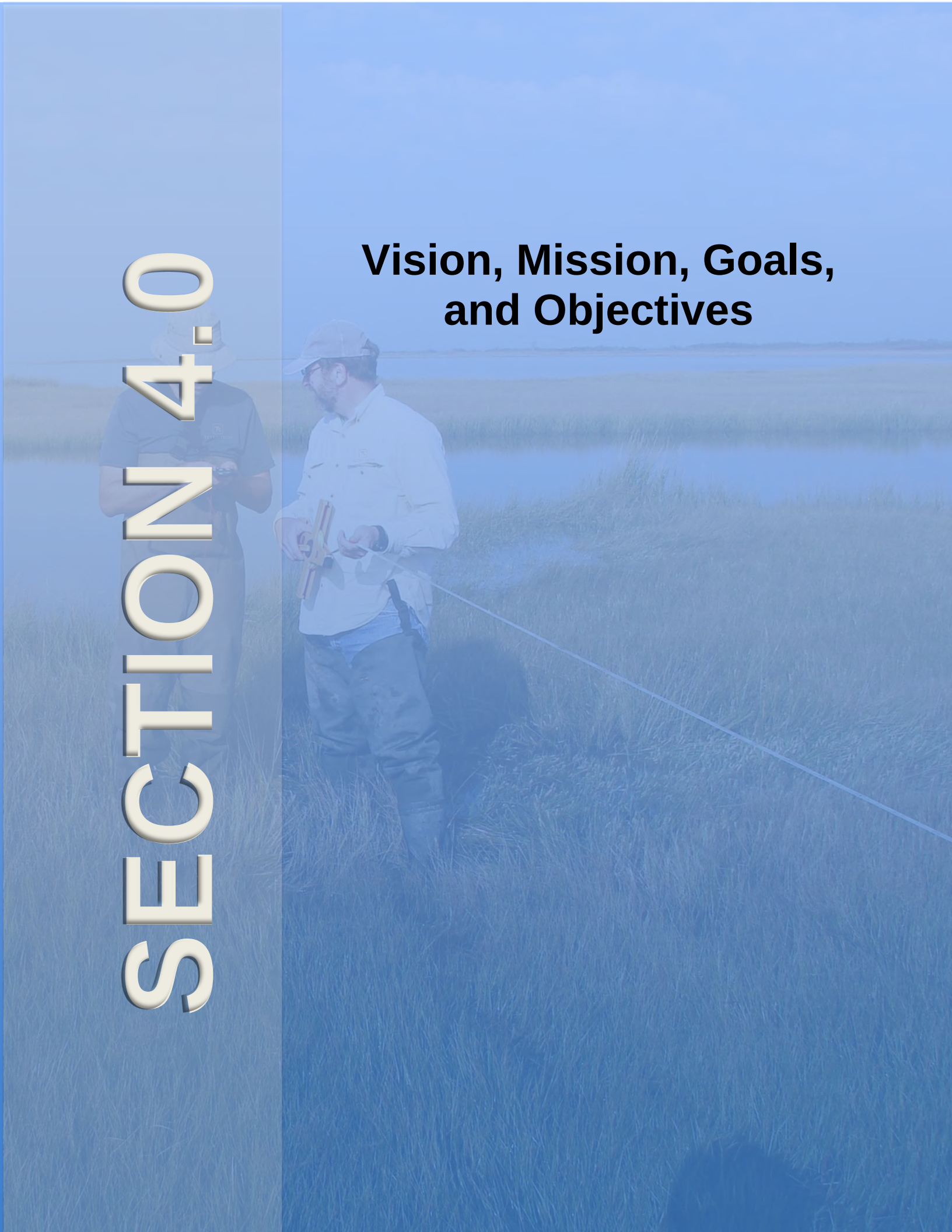


Question 8. What is your perception of the town's DWMP and SHI?

Respondents' answers with words like informative, excellent, more education, and greater importance.

SECTION 4.0

Vision, Mission, Goals, and Objectives



4.0 Vision, Mission, Goals, and Objectives

The Plan development team, town staff, and Advisory Committee reviewed the existing DWMP and SHI Program's vision, mission, and goals early in the Plan development process based on stakeholder interviews and community engagement. The team developed an updated vision and mission and developed more specific goals and objectives for the Plan.

4.1 Vision

The Town of Nags Head, through the SHI Program, establishes the promotion and implementation of decentralized wastewater management strategies for its residents, visitors, and neighboring coastal communities by implementing the current Decentralized Wastewater Management Plan (The Plan). The Plan will be dynamic and evolving over time so that decentralized systems remain a sustainable component of Nags Head's infrastructure that supports its residents, the economy, water quality, and the environment.

4.2 Mission

Decentralized Wastewater Management Plan Mission (2021):

The purpose of the Decentralized Wastewater Management Plan (The Plan) is to develop a septic management plan to protect the quality of life by managing the town's decentralized wastewater resources and protecting the quality of the town's groundwater and surface water.

This plan will:

1. Be the professional resource for property owners and visitors on all things related to septic systems
2. Protect residential and small business property investments
3. Monitor critical environmental water quality resources to protect public health
4. Ensure continual program support for the DWMP and SHI by developing an internal workplan that addresses and accounts for annual programmatic financial needs, staffing needs, resources, and outreach materials to meet the items identified under the SHI

4.3 Goals and Objectives

The DWMP goals and objectives are as follows:

Goal #1: To be the professional resource for property owners and visitors on all things related to septic systems.

1. Utilize a variety of education and outreach formats to disseminate information on proper septic system use including routine maintenance, pump outs and inspections, potential public health and water quality impacts, and signs of system failure
2. Expand the current septic system inspection program as outlined by the Plan

Goal #2: To protect residential and small business property investments.

1. Increase the value of water bill rebates and low-interest loan amounts and terms
2. Use scientific data to identify vulnerable areas with increasing groundwater levels, which may impact wastewater treatment

3. Evaluate water use versus permitted design flows to determine if systems may be overtaxed and water efficiency measures should be considered
4. Consider areas where environmental site conditions are changing or will potentially change in the future based on scientific studies, collected data, analysis, and future conditions. Consider off-site community decentralized cluster systems as a potential solution rather than individual system upgrades
5. Consider offering additional SHI services

Goal #3: To monitor our critical environmental water quality resources to protect public health.

1. Evaluate the current groundwater and surface water monitoring programs and recommend changes to better evaluate neighborhoods with increasing environmental risks
2. Coordinate all town programs and services, including the stormwater management program and other related programs and plans, to provide a comprehensive water quality improvement program or OneWater approach

Goal #4: Develop an internal workplan that includes a sustainable budget and identifies the resources and staffing needs for Plan implementation.

The Town of Nags Head DWMP Workplan will:

1. Evaluate data management needs for data input, connecting with external sources, and create tables and reports needed to continue to manage and grow the program
2. Consider expansion of website information including important external links and areas where increased access and visualization of data is needed for public use
3. Identify proposed areas where off-site community cluster decentralized wastewater systems should be considered due to vulnerabilities, and the steps needed for infrastructure financing and management project(s)
4. Identify changes to the water quality monitoring program to ensure full town coverage and automated sampling
5. Identify and justify any increase in staffing and related resources to ensure program is fully functional
6. Create a five-year budget that supports the workplan

SECTION 5.0

Relationship With Other Town Services, Plans, and Programs

5.0 Relationship With Other Town Services, Plans, And Programs

5.1 Introduction

The town departments or services most directly related to water resources include Planning, Engineering, and Water Services. All three departments have programs, resources, data collection, and reporting which can be used to inform the comprehensive picture of water resources in Nags Head. Through these departments, various datasets were compiled as part of this Plan including groundwater elevation and water quality, surface water quality, quantifiable and qualitative aspects of septic system inspection records, system treatment types, pump out credits, loans, permits, and water usage. Most of these datasets have been collected by the town, county, or state for years, but were not previously organized into a centralized, user-friendly database. Historically this data has been included in periodic reports (e.g., monthly, annual) but were not compiled in a meaningful way to assess correlations between datasets to understand the town's water resource health and risks.

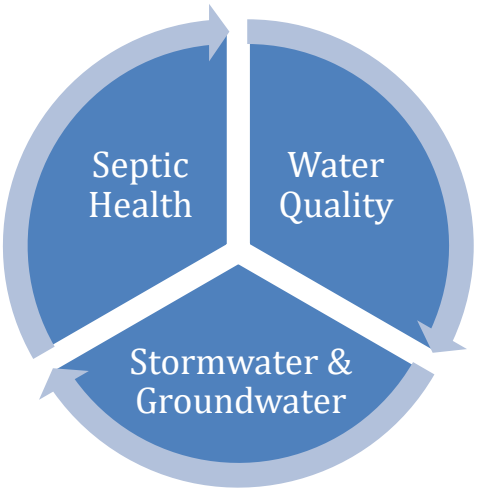


Figure 5-1. Relationship of septic health, water quality, and stormwater & groundwater

Specific data compiled for analysis throughout the Plan are summarized in various applicable sections, and are briefly summarized as follows by the various town departments:

- Septic Health
  - County Tax and Parcel Records
  - Inspection Records
  - Credits from Water Bill
  - Permit Records
  - Low-interest Loan Records
  - Water Quality and Bacteria Monitoring Data
- Water Services
  - Water Account Details
  - Water Usage Data
  - Water Leak Reporting

Additionally, relevant data collected by the town, their consultants, or other organizations pertaining to the surface water and groundwater water quality and quantity (e.g., water table elevations) were incorporated into the Plan.

5.2 Residential Energy and Water Conservation

High water usage from water leaks and dripping faucets can quickly overload a septic system. This can cause a mechanical malfunction resulting in little to no treatment of wastewater. Being water conscious can extend the life of a septic system. The Town of Nags Head's water services are managed by the Water Operations, Water Distribution, and Administrative Services Departments of the Town. These departments are responsible for supplying, tracking, billing, and maintaining the Town's assets related to potable water resources.

The town operates a “purchased” water system, in which water is purchased in bulk from Dare County and retailed to the businesses, institutions, and residences within the town. Nags Head Public Works Department’s Water Distribution division maintains over 102 miles of water distribution lines, ranging from 2 inches to 14 inches in diameter, and 4,838 metered connections. Water Operations and Water Distribution departments work to ensure that water received from Dare County is properly stored, treated, and distributed to water customers in Nags Head. The Department maintains water storage and pumping infrastructure, water distribution lines, as well as other infrastructure including valves, hydrants, taps, and meters.

Administrative Services manages a comprehensive database of all water accounts across the Town with authority over starting, continuing, or stopping water services. General activities include account setup, service stoppage, billing and payments, leak reporting and maintenance, and leak-related account adjustments. The Administrative Services division has maintained water usage data organized by account number, with total gallons used annually for every property by fiscal year. Records have associated unique parcel numbers identified for many accounts, but not all. Water accounts are identified with a status for water usage and irrigation usage (active, inactive, or none), owner names, property street addresses, and account types (residential, commercial, government, church, hospital, school, and park). Administrative Services maintains over 5,000 unique water accounts, with less than 100 additional accounts per year. Analysis of water usage data from 2011 through 2020 by aggregated land use type illustrates the order of magnitude of usage by land use, for which residential accounts dominate, followed by commercial accounts, and all other land uses account for relatively small volumes (Figure 5-2, Figure 5-3). Water usage over the past decade shows general upward trends as expected with increases in development, increased population, and visitors.

Analysis of water usage data from 2015 through 2019 for residential and commercial properties on a parcel basis can be used to analyze spatial trends (Figures 5-2 through 5-5 below). The mean annual water usage data indicates the largest residential water users are in the northern part of the town. For commercial properties, total average water usage is concentrated in the northern part of the town, which is where the vast majority of commercial properties are located. The split of total water usage for residential and commercial properties that are oceanside versus soundside is relatively similar on either side of NC 12. Residential design usage of onsite wastewater management systems is typically 120 gallons per day (gpd) per bedroom.

In addition to customer water loss, the Town’s own infrastructure is susceptible to leaks and breakage. Undetected leaks in Town distribution lines can further contribute to excess water impacting groundwater tables and causing increases in groundwater tables that impact the functionality of septic systems. On average, the Town repairs three (3) to four (4) water distribution line leaks annually.

In the future, the Town could consider the purchase and installation of smart water meter technologies to more quickly detect and repair leaks to both property owners and the Town’s infrastructure. Additionally, increased outreach and education is needed on water conservation measures, how to prevent and detect leaks, and Town services available to property owners such as seasonal meter turn-off. Further, increased communication between Administrative Services and the SHI about water leak detection and the potential impacts on septic system functionality could work to prevent septic system malfunction and failure related to water leaks. The Town is currently developing a Residential Energy and Water Conservation Guide through a grant received from the North Carolina Chapter of the American Institute of Architects. This guide will serve as a resource for residents to identify actionable ways to incorporate more energy efficient and water efficient measures into home designs as part of new construction and opportunities for retrofit.

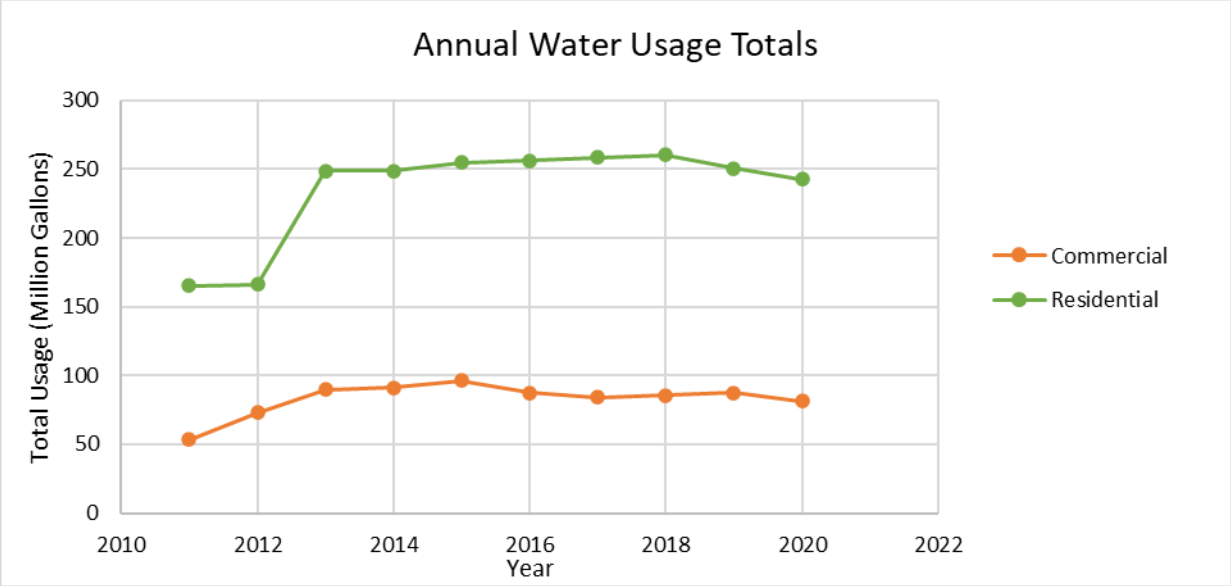


Figure 5-2. Total average water usage for commercial and residential land uses in Nags Head 2011-2020

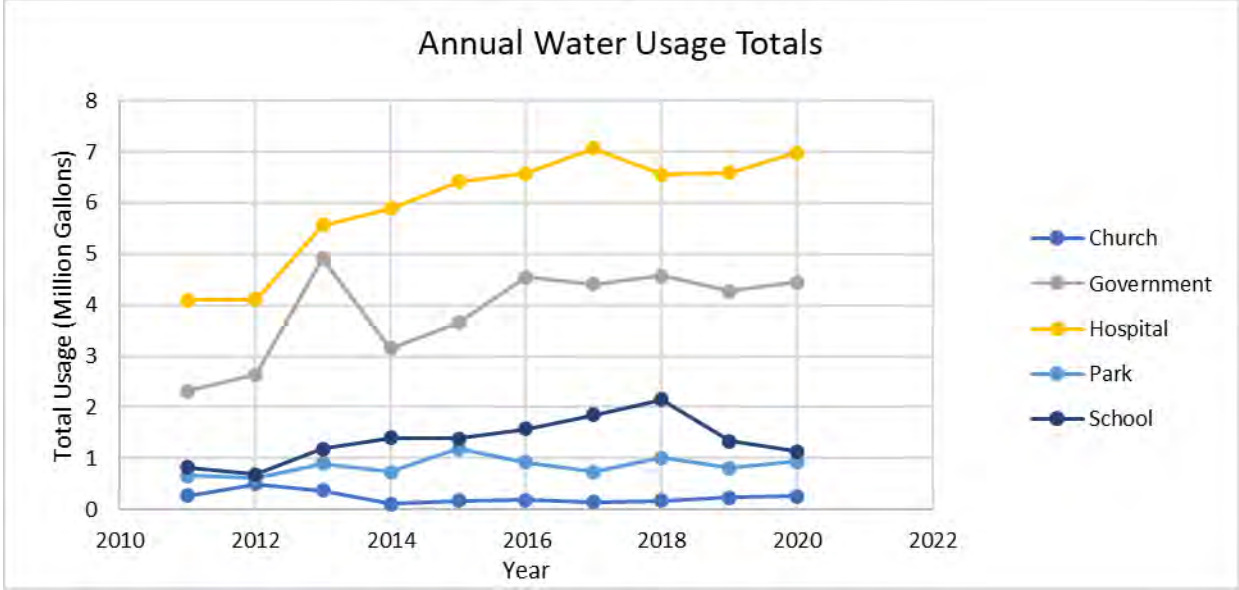


Figure 5-3. Total average water usage for various other land uses in Nags Head 2011 to 2020

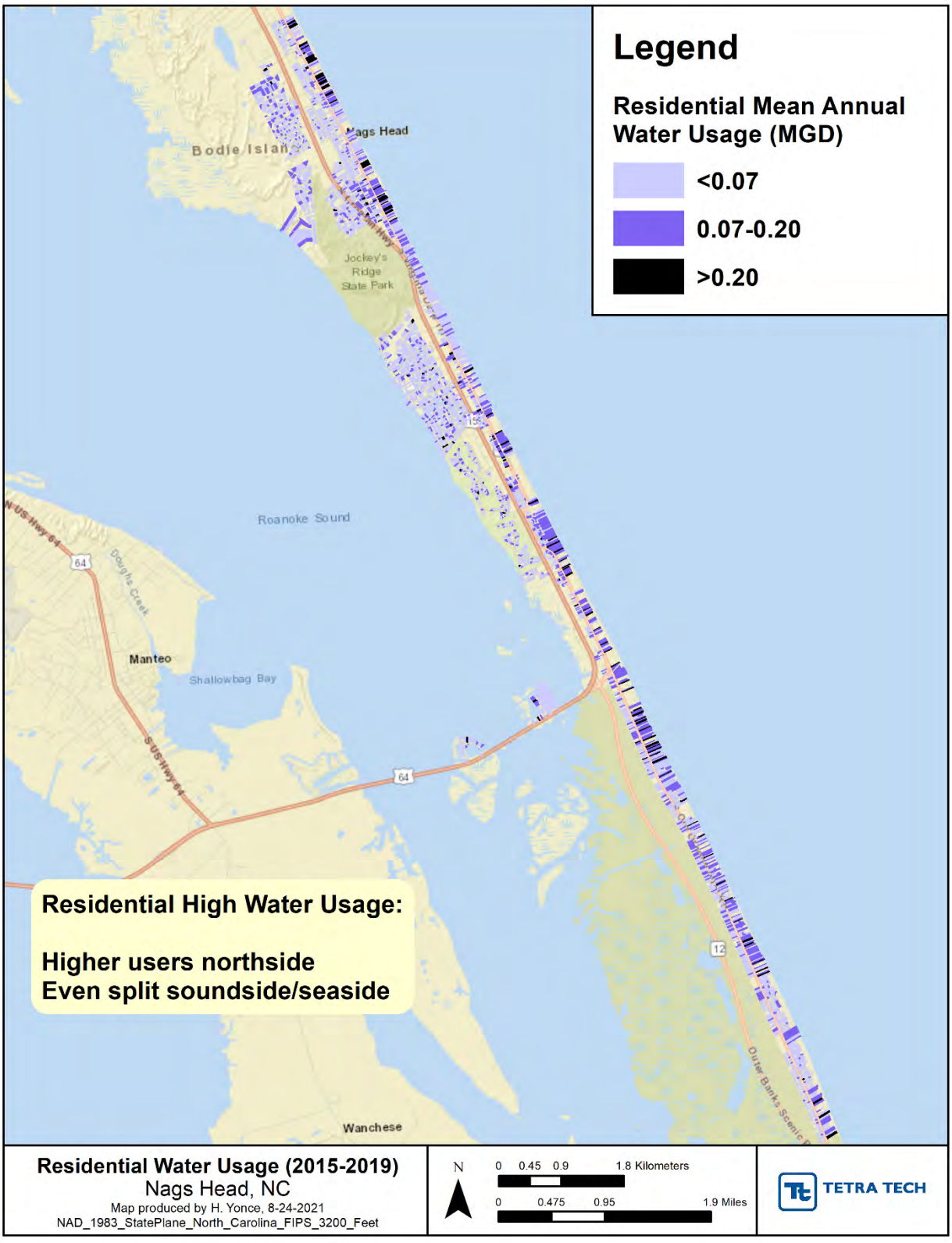


Figure 5-4. Average 2015 to 2019 parcel-based residential water usage data for Nags Head

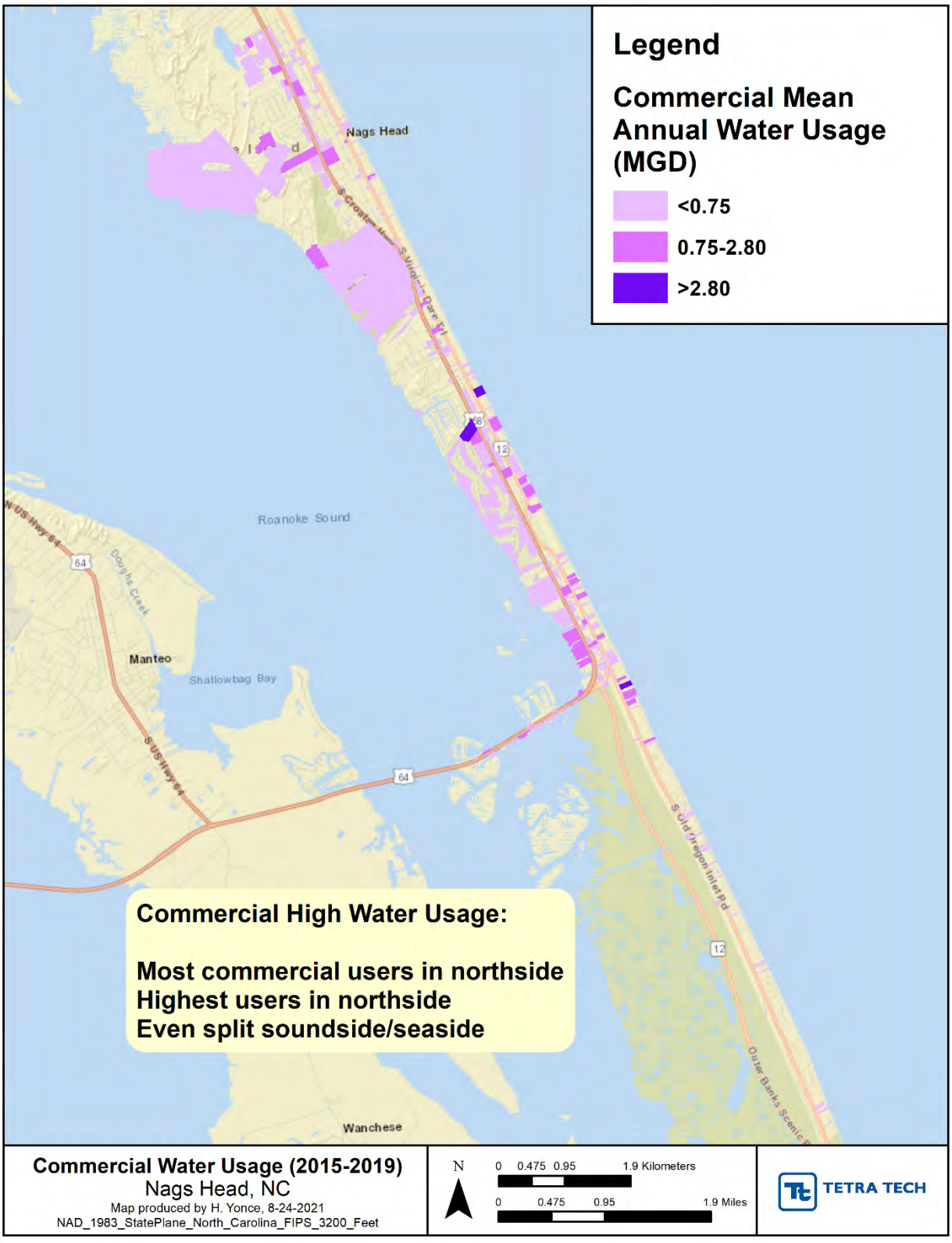


Figure 5-5. Average 2015 to 2019 parcel-based commercial water usage data for Nags Head

5.3 Stormwater

5.3.1 Stormwater Management Program

The Stormwater Management Program mandate as detailed on the town's website is to:

> "Improve the collection, treatment, and transportation of stormwater runoff through publicly owned infrastructure while enhancing pollutant removal prior to discharging to receiving waters. Program responsibilities include maintaining and repairing existing facilities, constructing new facilities, educating the public, and developing plans."

Stormwater management services include compliance activities related to federal, state, and local municipal stormwater requirements with development, public education and outreach, and a suite of other pollution and erosion prevention activities. Program activities that are linked most closely to wastewater management are those related to stormwater infrastructure and water quality.

The Town's stormwater infrastructure is intended to convey stormwater from developed areas to the sound or ocean effectively and efficiently (Figure 5-6). Infrastructure includes ditches, curb and gutter, curb inlets, catch basins/manholes, pipes, and stormwater control measures (SCMs). Stormwater runoff picks up all manner of pollutants as it flows across developed lands, including parking lot runoff pollutants, nutrients from fertilizers, sediment from construction sites, and bacteria from flooded and impaired septic systems. SCMs provide opportunities to collect stormwater and treat it for various pollutants so the discharging water does not become a direct conduit for pollution from malfunctioning septic systems to discharge into the sound or ocean. The town currently maintains geospatial data for nineteen (19) SCM features identified as retention and detention ponds.

Nags Head experiences flooding related to three different types of flood waters, those associated with groundwater rising, flooding from the ocean or sound along coastlines, and flooding from surface water features:

- **Groundwater Flooding:** Causes for rising groundwater levels may be attributed to heavier and more frequent rainfall events, changes to tidal patterns, changes in sea level elevations predicted from global climate change models, and the impacts of withdrawing water from deep aquifers which recharge surficial aquifers. Areas at high risk are those of low elevation and those adjacent to stormwater drainage systems which may have flow patterns disrupted under future conditions.
- **Coastal Flooding:** Causes include storm surges and high tides coinciding with hurricanes, tropical storms, nor'easters, and other low-pressure storm systems. Flooding includes over wash of oceanside coastal dunes or estuarine shorelines along the soundside. Areas at high risk for coastal flooding are defined by Special Flood Hazard Areas regulated by the town's Flood Damage Prevention Ordinance[13] (Figure 5-7).
- **Surface Water Flooding:** Causes include prolonged, heavy rain and high intensity short duration storms which lead to ground saturation, which overwhelms swales and other surface drainage features that carry stormwater away. Areas at high risk are low-lying areas, densely developed areas with high impervious coverage, and low-lying properties adjacent to stormwater system infrastructure.

[13] https://library.municode.com/nc/nags_head/codes/code_of_ordinances?nodeId=PTIIUNDEOR_ART11ENRE_PTIIIFLDAPR

Figure 5-6. Select existing stormwater infrastructure across Nags Head

5.3.2 Town of Nags Head Stormwater Master Plan and Residential Stormwater Program

The Town of Nags Head believes that good environmental stewardship includes providing a safe and healthy place for residents and visitors alike and can be achieved in an environmentally sensitive manner. The mission of the overall stormwater management program is to manage the impacts associated with stormwater runoff via policy development, regulations, and publicly owned infrastructure to reduce flood frequency and enhance pollutant removal via management strategies.

The existing publicly owned drainage system relies heavily on five (5) ocean outfalls which are maintained by the North Carolina Department of Transportation (NCDOT). Four of the outfalls are located within town limits and the fifth is located immediately south of the Town boundary. The outfalls were originally constructed to provide drainage relief for ocean overwash events when the storm surge from the ocean overtopped the dunes. With the implementation of beach nourishment project work, the frequency of ocean overwash has been reduced significantly. In addition to the ocean outfalls, twelve (12) estuarine outfalls exist along the western portion of the Town draining to the Roanoke Sound. A network of approximately 55 miles of storm drains, open channel ways, culverts, and swales provide drainage connectivity to the Atlantic Ocean or the Roanoke Sound.

Policy development for stormwater management is another management tool to address flood control and water quality. The Town of Nags Head Unified Development Ordinance provides developmental regulations that address stormwater management for both residential and commercial development. The goal of the regulations is to provide controls for stormwater runoff at the source, enhance infiltration and reduce the quantity of stormwater runoff conveyed to adjoining surface waters. Failing septic systems can have a direct impact on surface water. Once a septic system fails and untreated wastewater effluent enters either groundwater or surface water, increased levels of nutrients can exceed water quality samples levels, particularly NO_3^- which is a key indicator of failure. As noted in Section 7.4 Water Quality and Bacteria Data Analysis, multiple water quality monitoring locations in Nags Head were in exceedance of established water quality limits.

Untreated stormwater can then carry the nutrient loaded runoff to surface waters. There are several potential solutions to aid in stormwater treatment in areas with high nutrients, including:

1. Septic maintenance such as regular pump outs every three to five years or more frequently depending on usage.
2. Septic System repair or replacement with a new system or advanced treatment.
3. Stormwater treatment at the source or as close to the source as possible may include residential rain gardens or a bioswale near property runoff. Note that plants and trees should not be installed over the septic tank or drain field.
4. Stormwater Control Measures (SCM) to treat the stormwater utilizing native non-invasive plants to uptake the nutrients include areas like constructed wetland ponds located near a swale without compromising the carrying capacity, bioretention ponds, and bioswales in dry ditches.

5.4 Town Plans and Management Tools

5.4.1 Town of Nags Head Comprehensive Plan

The Nags Head Comprehensive Plan is an official policy document adopted by the Town of Nags Head to strategically plan for and enhance the quality of life and physical character of the community. The plan, while not regulatory in nature, builds upon adopted plans and policies to provide a foundation for decision

making, future regulations, and project development. Further, the plan was created utilizing community input to illustrate a vision for the future of Nags Head and define steps to secure that future.

Comprehensive Plan Section 3.3.4. addresses Coastal Resiliency and Sea Level Rise and utilized the stakeholder input gathered as part of the Head Vulnerability, Consequences, Adaptation, Planning Scenarios (VCAPS) Report to form the policies and actions. A key action identified to implement Policy NR-16 Minimize impacts of future SLR, was to, “Maintain and expand the Septic Health Initiative by providing government assistance for septic retrofits, assisting homeowners in maintaining their septic systems, conducting more groundwater sampling, securing additional wells for sampling, developing partnerships to assist with the peer review of existing data, transitioning to a mandatory septic inspection program with incentives, and mapping of groundwater (Action NR-16e).”

Comprehensive Plan Section 3.3.6 tackles Water Quality and the SHI. In this portion of the Comprehensive Plan, the town explores the importance of water quality, connection of the town’s water bodies to the larger regional watershed system, current issues with water quality, and details of the SHI. The policies and actions contained in this section demonstrate the town’s commitment to water quality and the SHI. Policies NR-24 – NR-28 are geared toward maintaining and expanding the SHI as well as supporting water quality. While all the policies and actions support maintaining and expanding the SHI program, Policy NR-26 supports the work conducted as part of the DWMP Plan.

NR-24 Preserve, protect, and improve water quality and natural estuarine functions to ensure public health, protection of natural resources and habitats, and recreational use.

NR-25 Increase public understanding of the relationship between water quality, ecosystem health, and human health advisories relating to water quality.

NR-26 Maintain and expand the Septic Health Initiative.

NR-27 Develop and enhance relationships with the county, state, federal, non-profit, and Institutional partners to assist in research and educational efforts. This includes, but is not limited to, the Dare County Health Department, the Dare County Cooperative Extension, Jockey’s Ridge State Park, the National Park Service, the Nature Conservancy, the Coastal Federation, the UNC Coastal Studies Institute, and other partners in the university system.

NR-28 Preserve and protect groundwater aquafers from depletion and contamination.

Many of the recommendations contained in Decentralized Wastewater Management Plan are identified and supported by the town’s Comprehensive Plan.

5.4.2 Town of Nags Head Vulnerability, Consequences, Adaptation, Planning Scenarios (VCAPS) Report

To begin identifying how proactive actions could increase resilience, the town partnered with North Carolina Sea Grant to conduct a project that explored how sea level rise might impact the town, its infrastructure, economy, and ability to provide services. To consider a broad range of possible options, this process focused on local community knowledge and perspectives on adaptations to potential hazards- including SLR. This project engaged the community through individual stakeholder meetings, a two (2) day workshop, and an eventual citizen advisory committee to assist in prioritization of actions over a two (2) year period. The VCAPS process is intended to help communities become more hazard resilient. During VCAPS, community members engaged in dialogue about future hazards, integrated local knowledge and experience about how the community will be impacted, identify gaps in data, knowledge or understanding, and think strategically about how to prevent harm by taking action in both the short and

long-term. Through the VCAPS diagramming process, participants were able to communicate what they felt were hazards stressors, outcomes of the hazard stressors, and potential consequences of both of these. In addition, this process further engaged participants in thinking about potential public and private actions to adapt to or mitigate the issues identified.

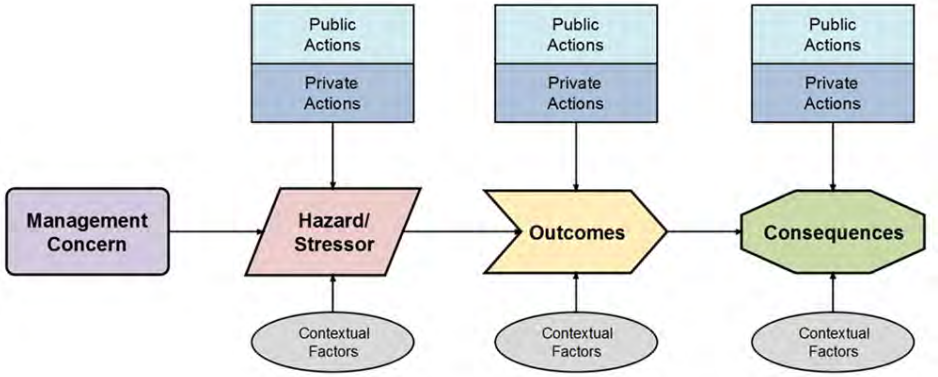


Figure 5-7. VCAPS Diagramming Process

The adaptation actions identified through community engagement were generally broken into five main categories: ocean management, estuarine shoreline management, stormwater management, water (ground/surface) management, and an “all issues” category in which the actions were identified by stakeholder groups. Based on the prioritization by stakeholders, key next steps for the town include maintain and expand the Septic Health Initiative, on-going monitoring of erosion rates, development of a comprehensive education and outreach program on resiliency and SLR, development of an estuarine shoreline management plan, and development of a plan for adaptation that includes a suite of SLR scenarios.

The Town of Nags Head VCAPS report contains an overall list of priorities as well as actions prioritized by management topic (VCAPS Appendix 3). For the overall priority actions (VCAPS Table 2) and the ground and surface water management area actions (VCAPS Appendix 3 & 4), maintaining and expanding the SHI was the top priority.

5.4.3 Town of Nags Head Flood Damage Prevention

When flooding occurs within Nags Head, standing water can sit on top of septic system drain fields and potentially cause a system failure. In addition, leachate can mix with floodwater and creating nutrient and bacteria concerns. Further, fill or mound septic systems can impact flood prone areas. The cumulative impacts of septic systems with fill have the potential to contribute to flooding of low lying adjacent septic system drain fields. Septic system design should take into consideration the impacts of fill on surrounding systems and low-lying areas under the Flood Damage Prevention ordinance, State, and Federal regulations.

The town’s Unified Development Ordinance (UDO) Article 11, Part III Flood Damage Prevention governs development in areas prone to flooding. These regulations work to promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions within flood prone areas.

5.4.4 Coastal Area Management Act (CAMA)

In 1974, the North Carolina General Assembly passed the Coastal Area Management Act (CAMA)[14] and set the stage for guiding development in fragile and productive areas that border the state's sounds and oceanfront. This legislation established the CRC (Coastal Resources Commission) as the governing body for CAMA. As a part of this program, the CRC designated "Areas of Environmental Concern" within the 20 coastal counties and set rules for managing development within these areas. An Area of Environmental Concern, or AEC, is an area of natural importance: It may be easily destroyed by erosion or flooding; or it may have environmental, social, economic, or aesthetic values that make it valuable to our state. CAMA rules and setbacks apply to many types of development from grading, residential and commercial construction, piers, and septic systems.

[14] Coastal Resources Commission Rules | NC DEQ

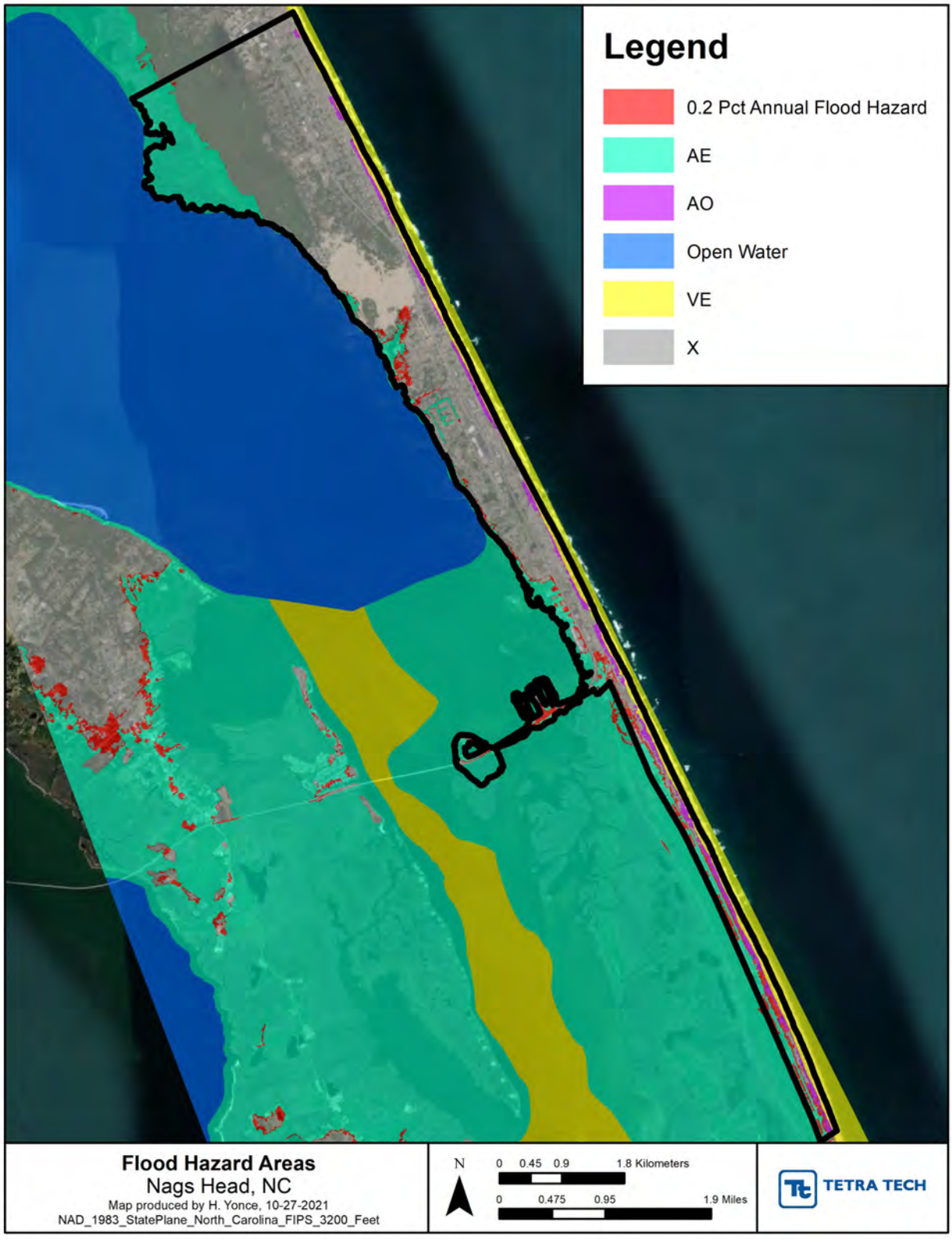


Figure 5-8. Flood Hazard Areas Across Nags Head

5.5 Recommendations and Action Items

The following recommendations are necessary to assist in continuing a proactive DWMP:

1. Continue to build and update Excel database that links information to the parcel number. This will allow for ease of use and tracking the recent septic system inspections, pump out rebates, and system repairs/replacements. The Excel database can also have pivot tables and macros to help query data for reporting purposes.
2. Develop a consistent method for collecting and reporting data based on need.
3. Determine and report water usage.
4. Collect important septic system data as building permits are filed with the town.
5. Obtain and process Dare County Environmental Health Septic Permit data and input into Town's Excel database.
6. Locate all residential septic systems at the time of inspection and compile Excel database.
7. Look at grant opportunities to survey septic systems.
8. Develop an online GIS layer for homeowners to be able to click on a parcel to obtain septic system information (installation date/age, type and size of system, recent inspection date and results, and most recent pump out date) and approximate location of septic system.

To achieve the above-mentioned recommendations for data management, the Town of Nags Head will need to budget resources including staff time to accomplish the recommendations. In addition, potential grant funding sources may be available through NCDEQ Viable Utilities Unit or NCDEQ Land and Water Fund to aid in the collection of septic system GPS data and GIS map development. Additional information on grants is discussed in further detail in Section 11.2 Grants and Loans.

SECTION 6.0

Onsite Wastewater Treatment System (OWTS) Background

6.0 Onsite Wastewater Treatment System (OWTS) Background

There are over 3,900 single-family homes in the Town of Nags Head that use OWTS or septic systems, as reported by Dare County Environmental Health Department. Septic systems are in-ground, soil-based treatment of wastewater primarily using a septic tank and drain field (also known as leach field) and may include pretreatment, pumping, or other onsite additions to increase effluent treatment based on site, environmental, and permitting conditions. The following sections will describe the various septic system types as classified in the Rules Governing Sewage Treatment and Disposal Systems under 15A NCAC 18A .1900[15] and NCGS 130A-333-345[16]) and approved products available for replacement system options for homeowners and neighborhoods.

The design of septic systems is based on the volume of wastewater that flows from the residence. Typically, the volume of flow is based on the number of bedrooms and the soil conditions (including soil texture and depth to groundwater). Each parcel's usable onsite lot treatment area (once minimum setback distances are applied, such as to roads, water lines, and property lines) is also calculated to determine the configuration of the septic system. The soil conditions set the Long-Term Acceptance Rate (LTAR) of the system based on the permeability of the soils, with sands having the highest LTAR and silts and clays with a low LTAR requiring a larger drain field. The Dare County Environmental Health issues the majority of permits for residential septic systems, and the North Carolina Department of Health and Human Services (NC DHHS) Environmental Health Section On-Site Waste Protection Branch (OSWPB)[17] and North Carolina Department of Environmental Quality Division of Water Resources (NC DEQ DWR)[18] directly regulate larger and more complex systems. The state agencies also assist with the repair or replacement design requirements. In cases of new construction, an owner would hire a Licensed Soil Scientist (LSS) to conduct the soil and site evaluation, and an Authorized On-Site Wastewater Evaluator (AOSE) or Engineer for an Engineer Option Permit (EOP). Once systems are permitted, a copy of the permit is provided to the town to obtain a building permit.

6.1 North Carolina Onsite Wastewater Treatment System Regulations

The Dare County Environmental Health Department administers permits for repairs, replacement, and new construction of onsite systems in Nags Head. The State of North Carolina develops the rules that are administered by the County. The rules include special NC DEQ DWR permits and operation conditions for more advanced treatment units and cluster treatment and drain field systems.

The proposed NC Rules for Onsite Wastewater (septic) Systems (NCAC 18 E[19]) contain restrictions impacting the siting, design, installation, and operation of onsite wastewater systems (septic systems). Approval for these proposed new rules is anticipated in 2022. Provisions in the proposed rules are similar to provisions in current Rule (15A NCAC 18A .1900), but new provisions in both the proposed rule and

[15] 1900RulesApril2017.pdf (ncdhhs.gov)

[16] ARTICLE 11 OF CHAPTER 130A (ncdhhs.gov)

[17] EHS: On-Site Water Protection Branch (ncdhhs.gov)

[18] Septage | NC DEQ

[19] https://cph.publichealth.nc.gov/Rules/EnvHealth/15A-NCAC-18E.pdf

the recent NC Budget Bill (SB 105, now SL 2021-180[20]) provides for wider acceptance of alternative wastewater treatment and management technologies.

Regardless, both proposed and existing rules recognize the site and soil assessment process as critical to siting, design, and successful operation of septic systems. The primary parameter recognized in the siting of a soil based onsite wastewater system remains the depth to seasonal water table. The soil texture (sand, silt, and clay content) also influences siting, sizing, design, and operational requirements associated with sub-surface wastewater treatment and dispersal systems. Rule 18A .1956 and 18E .0504 states that soil depth of 18-inches between the soil surface and seasonal water table is unsuitable to host a soil absorption system, but that limitation can be addressed by designing an advanced pretreatment system and a drip dispersal system. The Rule further states, that the separation distance between the water table and wastewater system must be at least 12-inches for soil groups II (coarse loam), III (fine loam), and IV (clays) and 18-inches for soil group I (sands) per 15A NCAC 18A .1970 and 18E .0510 (a)(3). The regulatory design/operation matrix below outlines requirements for septic systems.

Table 6-1. Design and Operation Matrix of Onsite Wastewater Treatment (Septic) Systems (per 15A NCAC 18A .1970 and 18E .0510)

Depth to Seasonal Saturation Groundwater (inches)	Septic Site Soil Suitability Classification	Onsite Option	Operator Inspection Frequency	Management Entity Oversight Frequency
48 or greater	Suitable	Conventional System	NA	NA
37 to 48	Provisionally Suitable	LPP or Shallow Placement	NA	NA
24 to 36	Special Design	LPP or Shallow Placement with ATU	4 times per year	Every 5 years
12 to 23	Special Design	ATU and Special Drip	4 times per year	Every 5 years[1]
12 or less	Special Design	ATU and Elevated Drip	4 times per year	Every 5 years[1]

[1] State regulations require oversight frequency increases beyond a design flow of 1,500 gpd

[20] Senate Bill 105 / SL 2021-180 (2021-2022 Session) - North Carolina General Assembly (ncleg.gov)

6.2 Soil Regulations, Requirements, and Types

In general, the State of North Carolina per 15A NCAC 18A .1956 (7)(j) requires a separation distance of 12-inches must be maintained between the zone of wastewater application and any indicator of seasonal soil wetness in finer textured soils (soil groups II, III, or IV), and 18-inches in sandy or coarse textured soils (soil group I). Soils found in Nags Head are primarily soil group I, sands. The soil wetness condition is determined by assessing the soil color as represented from the soil surface to a depth of at least 48-inches. A soil color described as “chroma 2” or lower is considered the indicator of soil wetness.

Sites considered suitable or provisionally suitable based on the soil color patterns are generally suited for conventional, gravity-based septic systems. Common septic dispersal options used in these situations are the standard gravel-based pipe and trench, open bottom chamber systems, multi-pipe systems, and bundled expanded polystyrene pipe systems.

Below is a map of soils found in the Town of Nags Head along with a table with soil descriptions and classifications.

The regulation Table 6-1. Design and Operation Matrix of Onsite Wastewater Treatment (Septic) Systems (per 15A NCAC 18A .1970 and 18E .0510) along with the soil map and classification Table 6-2. Soil Classifications and Descriptions below are shown here as guidance. These tables and maps along with field sampling are to be used together to aid in determining septic system type as approved by Dare County Environmental Health.

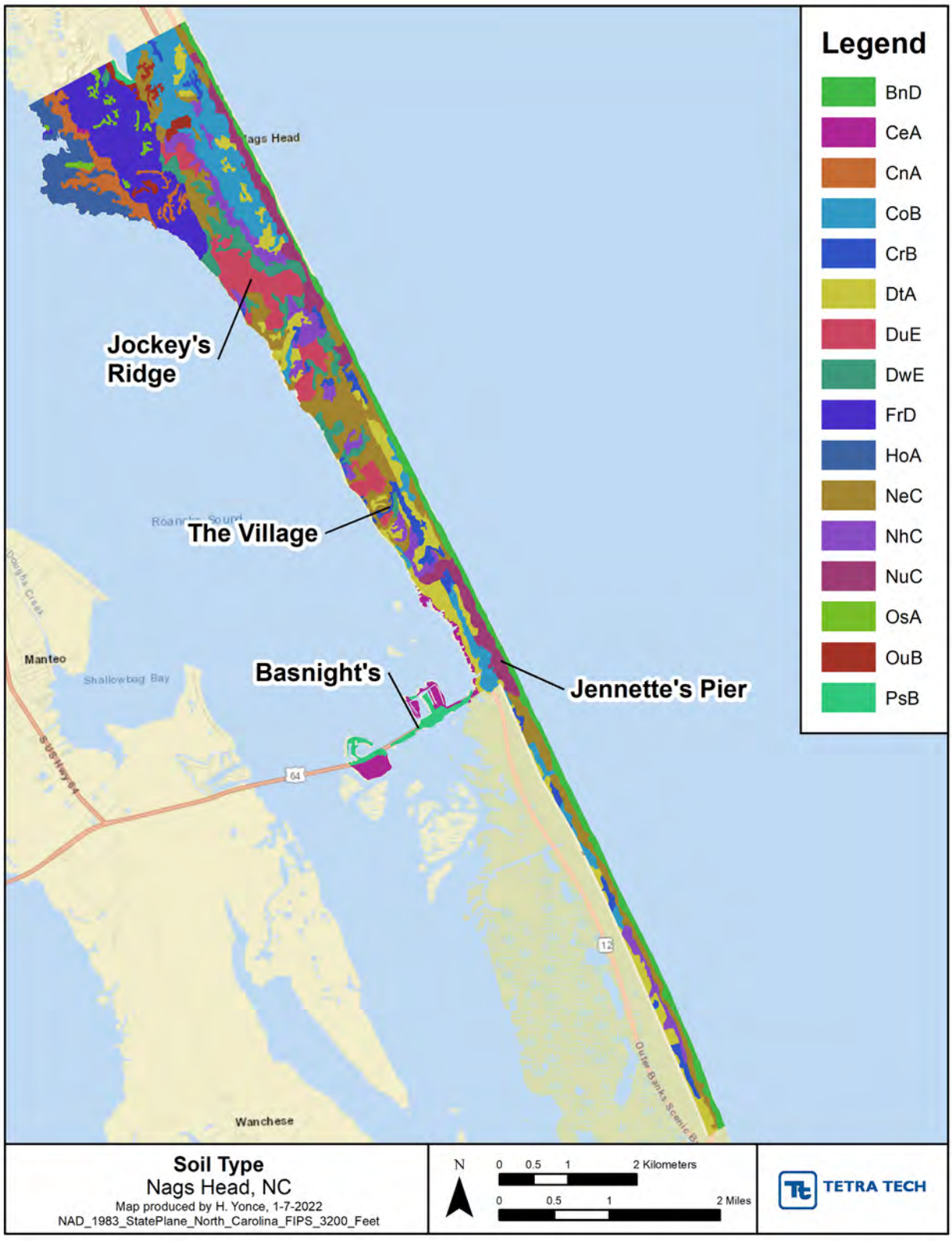


Figure 6-1. Soil Types across Nags Head

Table 6-2. Soil Classifications and Descriptions

Soil Type	Map Unit Name	Soil Rating	Landforms	Parent Material	Depth to Water Table (inches)	Drainage Class	Runoff Class
BnD	Beaches-Newhan complex, 0 to 25 percent slopes	Sand	Barrier beaches, barrier flats	Beach sand	0 - 6	Poorly drained	Very high
CeA	Carteret sand, 0 to 2 percent slopes, frequently flooded	Sand	Tidal Marshes	Sandy fluviomarine deposits and/or eolian sands	0 - 12	Very poorly drained	Very high
CnA	Conaby muck, 0 to 2 percent slopes, rarely flooded	Muck	Pocosins, depressions	Woody and herbaceous organic material over sandy and loamy fluviomarine deposits	0 - 12	Very poorly drained	Very high
CoB	Corolla fine sand, 0 to 6 percent slopes, rarely flooded	Fine sand	Troughs on barrier islands	Eolian sands and/or beach sand	18 - 36	Moderately well drained	Very high
CrB	Corolla-Duckston complex, 0 to 6 percent slopes, rarely flooded	Fine sand	Troughs on barrier islands	Eolian sands and/or beach sand	18-36	Moderately well drained	Very high
DtA	Duckston fine sand, 0 to 2 percent slopes, occasionally flooded	Fine sand	Depressions	Eolian sands and/or beach sand	0 - 6	Poorly drained	Very high
DuE	Dune land, 2 to 40 percent slopes	Fine sand	Dunes	Eolian sands	*unspecified*	*unspecified*	*unspecified*

DwE	Dune land-Newhan complex, 2 to 40 percent slopes	Fine sand	Dunes	Eolian sands	>80	Excessively drained	Medium
FrD	Fripp fine sand, 2 to 30 percent slopes	Fine sand	Dunes	Eolian sands and/or beach sand	>80	Excessively drained	Low
HoA	Hobonny muck, 0 to 1 percent slopes, frequently flooded	Muck	Marshes	Herbaceous organic material and/or woody organic material	0 - 6	Very poorly drained	Negligible
NeC	Newhan fine sand, 0 to 10 percent slopes	Fine sand	Dunes	Eolian sands and/or beach sand	>80	Excessively drained	Very low
NhC	Newhan-Corolla complex, 0 to 10 percent slopes	Fine sand	Dunes	Eolian sands and/or beach sand	>80	Excessively drained	Very low
NuC	Newhan-Urban land complex, 0 to 10 percent slopes	Fine sand	Dunes	Eolian sands and/or beach sand	>80	Excessively drained	Very low
OsA	Osier fine sand, 0 to 2 percent slopes, rarely flooded	Fine sand	Depressions	Eolian sands and/or beach sand	0 - 12	Poorly drained	Very high
OuB	Ousley fine sand, 0 to 5 percent slopes, rarely flooded	Fine sand	Troughs on dunes	Eolian sands and/or beach sand	18 - 36	Moderately well drained	Very low
PsB	Psamments, 0 to 6 percent slopes	Fine sand	Ridges on marine terraces	Sandy dredge spoils	>80	Excessively drained	Very low

Where there is an indication of a seasonal wetness condition between 24- and 36-inches, common septic dispersal systems used are a low-pressure pipe (LPP) system, drip dispersal systems, open bottom treatment/dispersal systems, shallow placed low-profile chamber, fill systems, multi-pipe, and expanded polystyrene pipe bundles. The LPP system and the drip system can generally be installed at a depth of 12-inches below the soil surface and still maintain a 12-inch separation distance to shallow groundwater. The chamber system, multi-pipe system, and expanded polystyrene bundles are typically placed in an 18- to 24-inch-deep trench, and the separation between trench bottom and seasonal saturation must be at least 12-inches. Since these gravity-based systems require a 6-inch soil cover over the distribution device, the devices are typically 12-inches in height and can maintain a 12-inch separation to the shallow groundwater when using shallow placement.

Where the depth to shallow groundwater is less than 24-inches, special design considerations may be employed. In general, options include the addition of soil atop the existing soil to create a “mound” or using advanced treatment to lower the pollutant concentration entering the soil treatment system. This type of system is characterized as a fill system. Options for adding soil include simple elevated systems or pressure dosed mound systems. These can be used provided the depth to seasonal saturation in the natural soil is at least 12-inches deep.

When considering mound and fill for septic systems, flooding impacts particularly regarding impacts to neighboring properties, dunes, protected habitats, and nearby wetlands will need to be analyzed and permitted as necessary under local, State, and Federal regulations.

In addition to these options, the NC DHHS DPH EHS treatment and dispersal products list includes anaerobic and aerobic drip systems. The drip tubing can be placed in a shallow (1-inch deep) trench in natural soil, covered with a 6-inch layer of soil lift, and utilized where a shallow water table is present.

The recent Budget Bill (SL 2021-180) recognizes onsite reuse technologies that, when designed for use in Class 1 soils, can be developed without the associated repair area required for all other septic systems.

The siting and sizing criteria associated with septic systems are listed in the existing onsite rules (15A NCAC 18A .1900 et sec.), in the proposed rules for septic systems (15A NCAC 18E .0100 et seq.), and in the 2021 Budget Bill recently signed by the Governor. Regardless, a common requirement of rules is to maintain a separation distance of 12-inches or more for installations in soil groups II, III, or IV and 18-inches for systems installed in soil group I unless some form of advanced pretreatment is used.

6.3 Septic System Types

There are many types of onsite septic systems ranging from conventional to advanced treatment and water reuse. The following subsections outline the basics of different types of septic systems. Other systems installed in Nags Head include Brunswick Bed Systems, systems with manifolds, systems in fill, and Prefabricated, Permeable Block Panel System (PPBPS). NC DHHS EHS has a list of approved, innovative, and accepted septic systems which is available online.[21] The system type refers to the operation and maintenance (O&M) and management requirements imposed on the various wastewater options through the state regulations and permits. The O&M and management requirements increase

[21] https://ehs.ncpublichealth.com/oswp/approvedproducts.htm

with system complexity of technologies and size from Type II to VI. Type I regulates alternative toilets and grease traps.

Onsite septic systems and decentralized cluster systems all require operation and maintenance (O&M) and as a system gets larger and more complex other wastewater management activities are required, like owning and operating a utility. The county and state permitting programs require various levels of O&M and management depending on each septic system treatment type as outlined in the rules and in the individual permits. While conventional septic system permits may not contain specific O&M requirements, they do need attention with inspections and tank pump outs to preserve the integrity of the drain field. Otherwise, not arranging for a simple tank pump out can allow solids to escape the tank and enter the drain field, triggering a more extensive and expensive repair.

Table 6-3 identifies the O&M and management requirements by system type. Note that the Management Entity for conducting inspections, monitoring, and pumping out tanks is the homeowner's responsibility unless a Responsible Management Entity (RME) is formed and oversees these activities. Also note that system Types IV, V, and VI require certified operators or an RME.

Table 6-3. Septic System Types and Management Responsibilities (per 15A NCAC 18A .1961)

System Classification	System Description	Management Entity	Minimum System Inspection/Maintenance Frequency
Type I	a. Privy b. Chemical toilet c. Incinerating toilet d. Other toilet system e. Grease trap	Owner	N/A
Type II	a. Conventional septic systems (single-family or 480 GPD or less) b. Conventional septic system with 750 linear feet of nitrification or less c. Conventional system with shallow placement	Owner	N/A
Type III	a. Conventional septic system > 480 GPD (excluding single-family residence) b. Septic system with single effluent pump or siphon c. Gravity fill system d. Dual gravity field system e. PPBPS system, gravity dosed	Owner	N/A

	f. Large diameter pipe system g. Other non-conventional trench systems		
Type IV	a. Any system with LPP distribution b. System with more than 1 pump or siphon	Public Management Entity with a Certified Operator or a private Certified Operator	2 times per year
Type V	a. Sand filter pretreatment system b. Any > 3,000 GPD septic tank with a nitrification field designed for > 1,500 GPD c. Advanced (Aerobic) Treatment Unit (ATU) d. Other mechanical, biological, or chemical pretreatment plant (< 3,000 GPD)	Public Management Entity with a Certified Operator or a private Certified Operator	a. 2 times per year (0 to 1,500 GPD) 4 times per Year (1,500 to 3,000 GPD) 12 times per year (3,000 to 10,000 GPD) 1 time per week (> 10,000 GPD) b. 12 times per year (3,000 to 10,000 GPD) 1 time per week (> 10,000 GPD) c. 4 times per year d. 12 times per year
Type VI	a. Any > 3,000 GPD system with mechanical, biological, or chemical pretreatment system plant b. Wastewater reuse/recycle	Public Management Entity with a Certified Operator	a. 1 time per week (3,000 to 10,000 GPD) 2 times per week (10,000 to 25,000 GPD) 3 times per week (25,000 to 50,000 GPD) 5 times per week (> 75,000 GPD) b. 12 times per year

6.3.1 Conventional Septic System (Type II or III)

A conventional septic system collects the solids and wastewater into a tank and begins the treatment process by settling out the solids and trapping grease and oils. The effluent outlets the tank typically through an effluent filter and flows by gravity to the distribution device and into a drain field gravel bed or trenches via a series of PVC pipes with holes. The effluent moves through a series of parallel pipes via gravity flow and percolates into the surrounding soils both outwards and down. A biomat typically forms at the gravel-soil interface. Over time, or if the system is overloaded with high wastewater flows or grease or solids leave the septic tank, the biomat may create a failure either by surfacing or backing up into the home. Surrounding soils, particularly the soils directly below the drain field and above the groundwater table, then acts as a large filter removing nitrogen, phosphorus, and bacteria before the now treated liquid enters the groundwater aquifer via soil absorption.

Several alternative drain field materials can take the place of the typical pipe and gravel. These include plastic chambers, large diameter pipe, and wrapped pipes. Some of these options receive reductions in sizing due to increased treatment potential.

Fill or mounded systems can be gravity or pressure distributed depending on design standards.

If the drain field requires shallow placement or to be in fill, a pump tank will be needed to lift the effluent to either distribute under pressure, or to pump to gravity distribution.

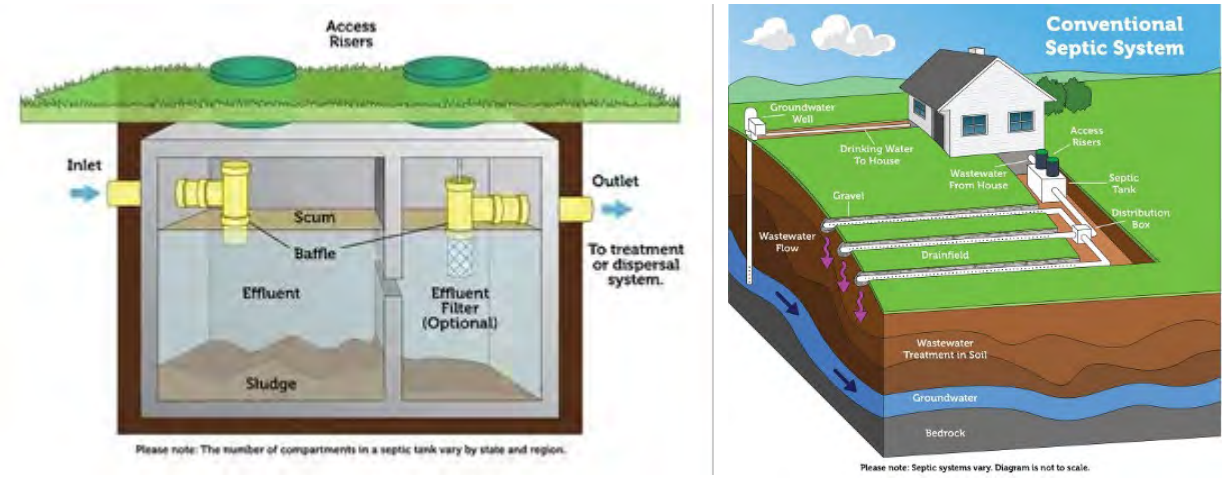


Figure 6-2. Septic tank elevation view (left) and a conventional septic system (right) source: EPA

6.3.2 Low Pressure Pipe (LPP) System (Type IV)

According to the NCDENR Rules, “Low-pressure pipe (LPP) systems with a two to five-foot pressure head may be utilized on sites which are SUITABLE or PROVISIONALLY SUITABLE for conventional or modified systems or on sites where soil and site conditions prohibit the installation of a conventional or modified septic tank system.” An LPP system is a shallow, pressure-dosed soil absorption system with a network of small diameter perforated pipes placed in narrow trenches. LPP systems are typically comprised of a septic tank plus a pump tank or chamber with dosing occurring through small diameter distribution laterals. The advantage of the LPP over conventional systems is it provides improved effluent distribution uniformly throughout the drain field area, can enhance aerobic conditions through periodic dosing and resting cycles, and can result in a reduction, (approximately 1/3), of land area compared to conventional wastewater systems.

6.3.3 Drip Distribution (Type IV or V)

A similar type of pressure-dosed dispersal system is a drip distribution system that starts with the standard septic tank, which is followed by a tank for the hydraulic dosing equipment. Small diameter tubing is laid out in the drain field area, greatly reducing the depth of the stone gravel, and supplying small, timed doses of the effluent throughout the distribution system. The system can be preceded by advanced treatment, or with septic tank effluent. Benefits include the shallow placement of the system and providing irrigation for lawn areas.

6.3.4 Advanced (Aerobic) Treatment Unit (ATU) (Type V)

Advanced or Aerobic Treatment Units (ATUs) provide wastewater treatment before dispersal to the drain field. These units may follow or incorporate the septic tank as the first component, typically followed by either adding air to the wastewater or dispersing the effluent across an unsaturated medium either once or multiple times (like a media or recirculating sand filter). The treatment can greatly reduce the pathogens, wastewater strength, and convert ammonia to nitrates to further the denitrification process. Another benefit to ATUs is that they can reduce the buildup of a biomat in the drain field which can increase the longevity of the drain field. Some ATUs provide nitrogen conversion and removal, which can be important in sensitive ocean environments.

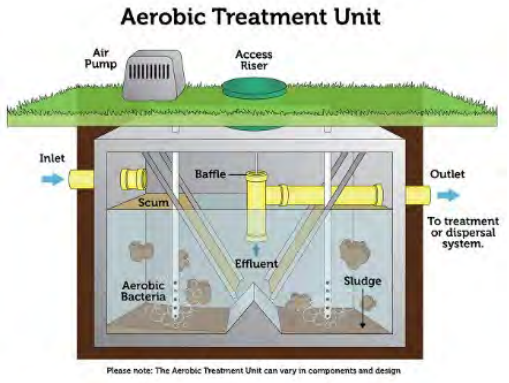


Figure 6-3. Advanced (Aerobic) Treatment Unit, ref. US EPA

6.3.5 Decentralized Cluster Systems (Type V or VI)

Decentralized Cluster or Community Septic Systems are appropriate when spatial or environmental conditions limit residential properties from being served by an individual septic system. A cluster system can be as simple as two or more neighboring homes collecting their wastewater together and sharing a drain field with easements to handle the ownership responsibilities. Each home may have individual septic tanks on their property, piping wastewater effluent for further treatment and dispersal to a shared drain field. Septic Tank Effluent Pump (STEP) systems or grinder pump systems are two types of collection systems used for cluster systems. Advanced treatment may be included to maximize drain field space, reduce nutrients and pathogens, or to avoid additional NC DEQ requirements for increased wastewater volumes.

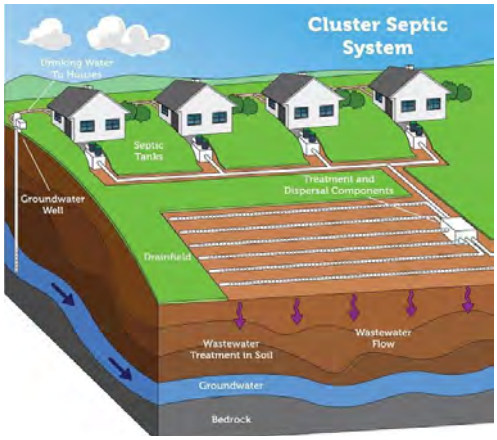


Figure 6-4. Decentralized Cluster System Layout, ref. US EPA

Decentralized cluster systems offer a great alternative to conventional central sewer, providing opportunity to share resources (money, space, and time), amongst multiple residences. See Appendix C for specific examples of potential application and scale of decentralized cluster systems relative to existing large and/or advanced onsite systems across Nags Head.

6.3.6 Water Reuse (WR) Systems (Type VI)

Water Reuse (WR) systems are designed to accomplish the highest levels of treatment so that the treated water can then be reused for specific purposes, such as surface irrigation or use inside the building for toilet flushing. These systems are like ATUs but require additional complexity, piping, and management to maintain proper public health and safety. One immediate opportunity for utilization of onsite reuse was that the application involved the reduction or elimination of repair areas for onsite systems where a water reuse system design to meet the current reuse standards has been developed.

The NC DEQ DWR currently recognizes conjunctive and dedicated water reuse efforts. The requirements for these programs are delineated clearly in State Rule (15A NCAC 02U et seq.). The State has permitted onsite reuse in a variety of applications: park and recreation facilities, businesses, and commercial facilities, planned developments, and single-family homes. The reuse activities include both indoor and outdoor uses.

The Plumbing Code for North Carolina also recognizes reuse opportunities. As the Town of Nags Head moves forward with decentralized and distributed wastewater management efforts, opportunities for water reuse may be incorporated into the plan. Technologies and standards exist today that achieve the levels of treatment required in current rules and the certified septic system operators have provided excellent service in support of these efforts.

The US EPA is currently assessing potential water reuse at the building, neighborhood, and community levels. Water is a precious resource, and the Agency recognizes that improved water management strategies for the future will require some level of reuse. As Nags Head examines wastewater management challenges and opportunities, treatment and reuse may be an additional option through initiatives such as a OneWater program or the Residential Energy and Water Conservation Guide.

SECTION 7.0

Analysis of the Todd D. Krafft Septic Health Initiative Program

7.0 Todd D. Krafft Septic Health Initiative Program Evaluation

As part of this Plan, the Septic Health Initiative (SHI) was evaluated to establish how the program has been used and could be better utilized to improve and promote septic system health. Approximately 80% of the properties in Nags Head are on septic systems, and there are no mandatory requirements that these systems be maintained or repaired after installation. Natural system failure occurs due to age, overuse, improper use, and environmental factors such as debilitating impacts from hurricanes or flooding from surface water, groundwater, or coastal sources. The Todd D. Krafft SHI was initiated in 2000 as a voluntary program for property owners which provides free services and financial assistance to single-family homeowners with small septic systems including septic system inspections, system pump out rebates, and low interest loans to repair and replace failed systems. The program also collects surface and ground water quality and bacteria samples to determine overall watershed health.

> *"Nags Head is a leader and innovator in continuing to promote its proactive voluntary septic system inspection and maintenance program. The Town recognizes that for these systems to sustainably meet wastewater management needs for the majority of Town properties in a manner that is optimally protective of public health and water quality, ongoing effective life cycle management is key. The program is a model for many other North Carolina coastal communities to consider emulating."*
>
> **- Steven Berkowitz, PE,** Senior Engineer, Division of Public Health On-Site Water Protection Branch, North Carolina Department of Health and Human Services

Evaluation of the SHI program included a review of inspection records, pump out rebates, engagement in the low-interest loan program for repairs and replacement, existing water quality conditions, and trends over time. As part of this review, recommendations are made for both new and expanded initiatives for homeowner engagement, and a proposed program database framework to effectively and efficiently manage all SHI data types and information in a meaningful way.

7.1 Septic System Inspections

The Town of Nags Head provides free septic system inspections to homeowners that have conventional septic systems that are sized less than 3,000 gallons per day. The town's inspection provides homeowners with valuable information on the functionality of the system, accumulation of solids or sludge, and recommendations on pumping or repairs.

Per Dare County Environmental Health, there are over 3,900 conventional septic systems that have tanks sized less than 3,000 gallons per day in the town. On average flow rates are calculated based on 120 gallons per day per bedroom. There are also several advanced treatment systems throughout the town that require an operator and 29 large systems that are over 3,000 gallons per day. Additionally, there are three (3) non-discharge permits from NCDEQ at Jennette's Pier, The Village at Nags Head, and The Villas Condominiums. There are two (2) discharge permits issued by NCDEQ at Jennette's Pier and Basnight's Lone Cedar Café.

Figure 7-1. Septic system inspection in Nags Head

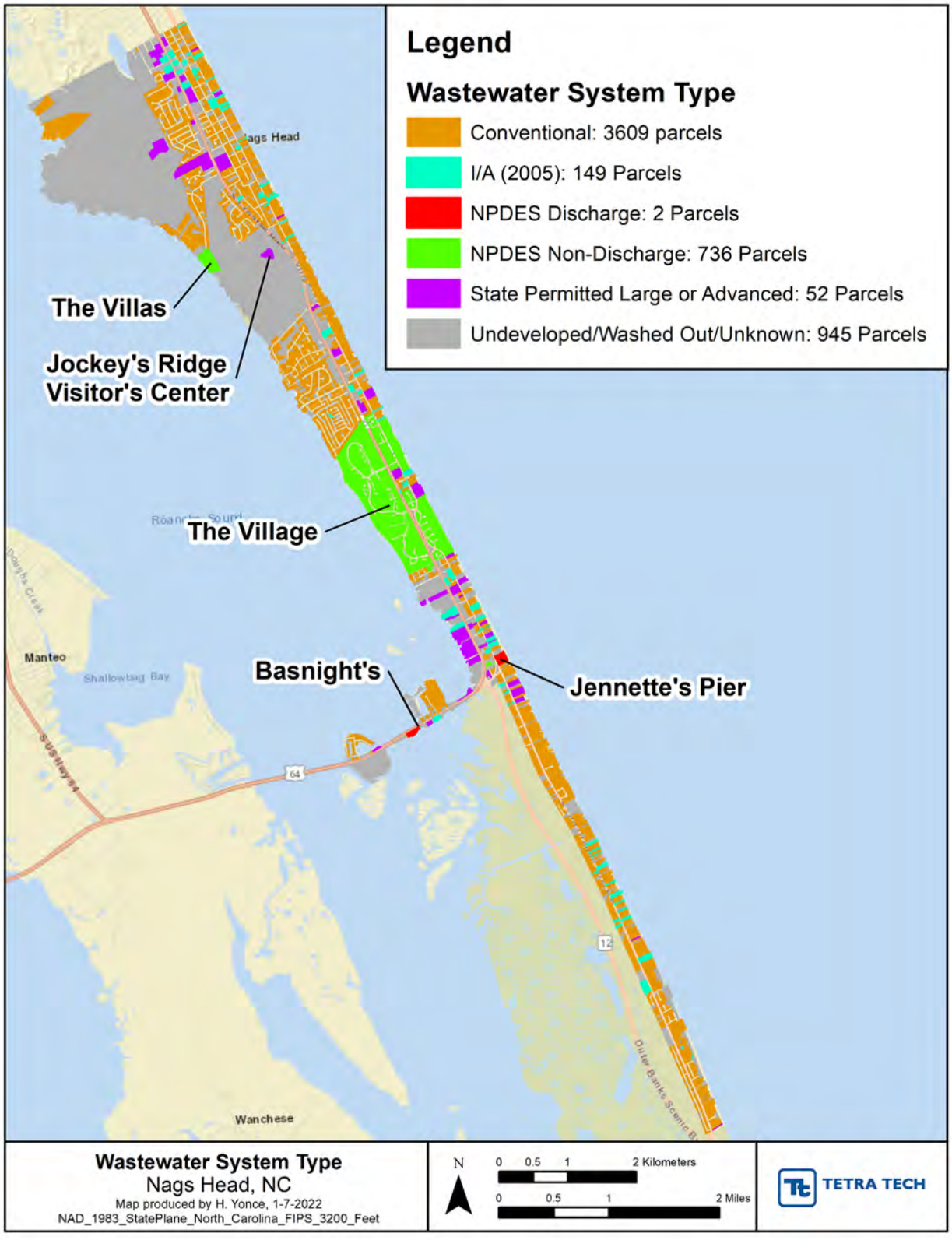


Figure 7-2. Wastewater System Types in Nags Head

Since 2005, over 2,330 septic system inspections have been conducted. On average the Town of Nags Head conducts 150 inspections annually. This equates to five percent (5%) of all conventional septic systems within the town. During the stakeholder interviews, public forum, and community questionnaire, a reoccurring theme came up; septic systems are sight unseen and homeowners frequently could not recall the last time that the septic system was inspected or pumped out.

To increase proactive maintenance, a goal of this program area is to increase the Town of Nags Head free septic system inspections from an annual average of between 120 and 150 inspections to 500 inspections by FY2027. The goal of 500 annual septic system inspections would allow small conventional systems to be inspected once every three to five years. This would ensure that most systems can be pumped as recommended every three to five years before a system failure. This goal could be increased to one-fifth (1/5) of all small systems or 700 annually in future years as the program grows.

7.2 Septic Tank Pump Out Rebates

Since 2005, the town has offered a water bill rebate when homeowners have their septic tank pumped out. This incentive is intended to encourage the safe and healthy operation of residential septic systems with regular operational maintenance. Regular system maintenance including inspections and pump outs avoids potential repairs or costly replacements. To maintain a functional septic system that will operate for a long duration, septic system pump outs should be conducted every three to five years depending on septic system usage, bedrooms, number of people occupying the house, and tank size.

Table 7-1. General Septic System Maintenance Schedule

Action	Rental Homes with Higher Usage than Design	Single Family Residential/Year-Round Homes (typical)*
Septic System Inspections	Annually	Every three to five years
Pump Out	Annually	Every three to five years

To receive the water bill rebate, homeowners must submit a paid invoice of pump out services to the town. The town currently provides a $45 rebate (revised in 2020 from $30) to homeowners for each completed pump out (limited to once per year).

Feedback from stakeholder meetings, perceptions from regional studies, public forum comments, and community questionnaire responses indicated that the pump out rebate program is a good incentive but may not be enough to entice homeowners to submit required paperwork to the town to obtain a $45 credit on their water bill. An annual average of 31 homeowners obtained the rebate since the program began. In total, town records indicate that a total of 423 total unique residences have engaged in the water bill rebate program (either once or multiple times each three-year cycle since 2000) since the program began (Figure 7-3). Rental homes or homes that have high water and septic usage may require a septic system pump out on an annual basis. Single-family three- and four-bedroom homes that are year-round residences or used more infrequently by the owner as a second home should be pumped out every three to five years.

Figure 7-3. Todd D. Krafft SHI pump out rebate map

To entice and reward homeowners for proactive septic system maintenance, increasing the pump out rebate incentive from $45 to $150 is recommended. This is half of the approximate cost of a system pump out. This increase will aid homeowners in pumping their septic systems every three to five years. To achieve this, a goal was set to allocate funding for 250 pump out rebates or half the septic system inspections goal of 500 annual inspections by FY2027.

7.3 Septic System Repair and Replacement Loans

The town offers low-interest loans for homeowners who choose to engage in onsite system repair or replacement for a failed system. The existing loan rate is the prime rate minus 2.5% (non-compounding) and can be paid back over 36 months, with a maximum loan amount of $7,500.

Since 2005, 133 homeowners have taken advantage of the loan program. As shown in the map below, 85% of the loans have been north of US 64 and 73% of loans have been located west of US 158 on the soundside.

Based on stakeholder interviews and material costs, it was determined that actual costs for conventional septic system replacements far exceed the maximum loan amount provided by the town due in large part to the cost of fill material. Typically, this fill is required as part of the septic permit to meet the separation requirements. The recommendation would be to increase the septic loan maximum amount from $7,500 to $12,000 to cover the cost of replacement or repair.

In addition, advanced treatment systems can be costly and can range from $20,000 to over $50,000. Homeowners with septic systems located in areas of low elevation, subject to flooding, and those with high groundwater tables may need to convert a conventional septic system to an advanced treatment septic system. As the town's groundwater elevations are more accurately obtained and mapped over time, the septic system loan maximum amount may need to be reevaluated based on need. Potential funding from a variety of state and federal sources may be available to assist homeowners in converting or replacing conventional septic systems to aid in mitigating widespread septic system failure, reducing risk through mitigation, and improving local and regional water quality. Additional details on grants can be found in Section 11.0 Program Budget and Funding.

Figure 7-3. Septic system replacement

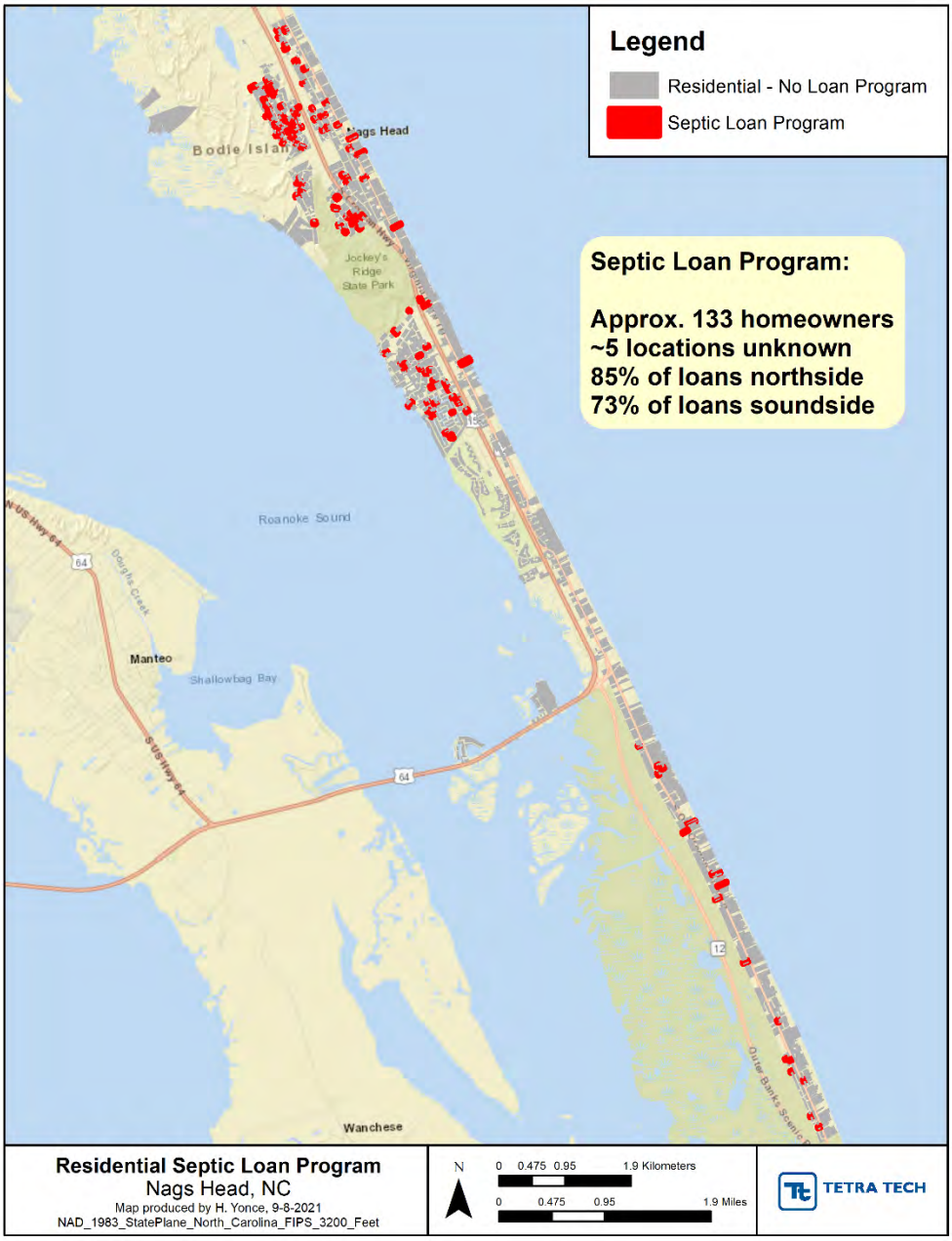


Figure 7-4. Septic System Loans Distributed Across Nags Head

7.4 Water Quality and Bacteria Data Analysis

Water quality data was analyzed across twenty-three (23) sites in Nags Head, spanning eleven (11) surface water sites, five (5) ocean outfalls, and seven (7) groundwater sites (Figure 7-5). Data were analyzed for the 2011 to 2020 time period, wherein water quality data was collected. Data was collected by contracted services from 2011 to 2018, then by town staff in 2019 to 2020 monthly from May through September. Parameters measured included nutrients NO_3, NH_3, TP, and bacteria fecal coliform, Enterococci, and *E. coli*.

Water quality data collected throughout Nags Head was consolidated and analyzed for this Plan to develop a more comprehensive, complete picture of the existing conditions the town faces related to water resources. Below is a summary of relevant water and water quality data analyzed as part of this Plan.

Figure 7-5. Surface Water and Groundwater Water Quality Sample Sites

7.4.1 Nutrients In Surface Water and Groundwater

Concentrations of TP and NH_3 were variable across and within sites, with no clear spatial pattern (Figure 7-6 through Figure 7-11). NO_3^- concentrations tended to be highest at more southern sites in Nags Head, with sites that experienced exceedances of the North Carolina water quality standard of 10 mg/L (North Carolina Administrative Code, 2021) located at the Old Nags Head Cove, Bypass, and Juncos sites. Exceedances of the NO_3^- standard were found at both surface and groundwater sites.

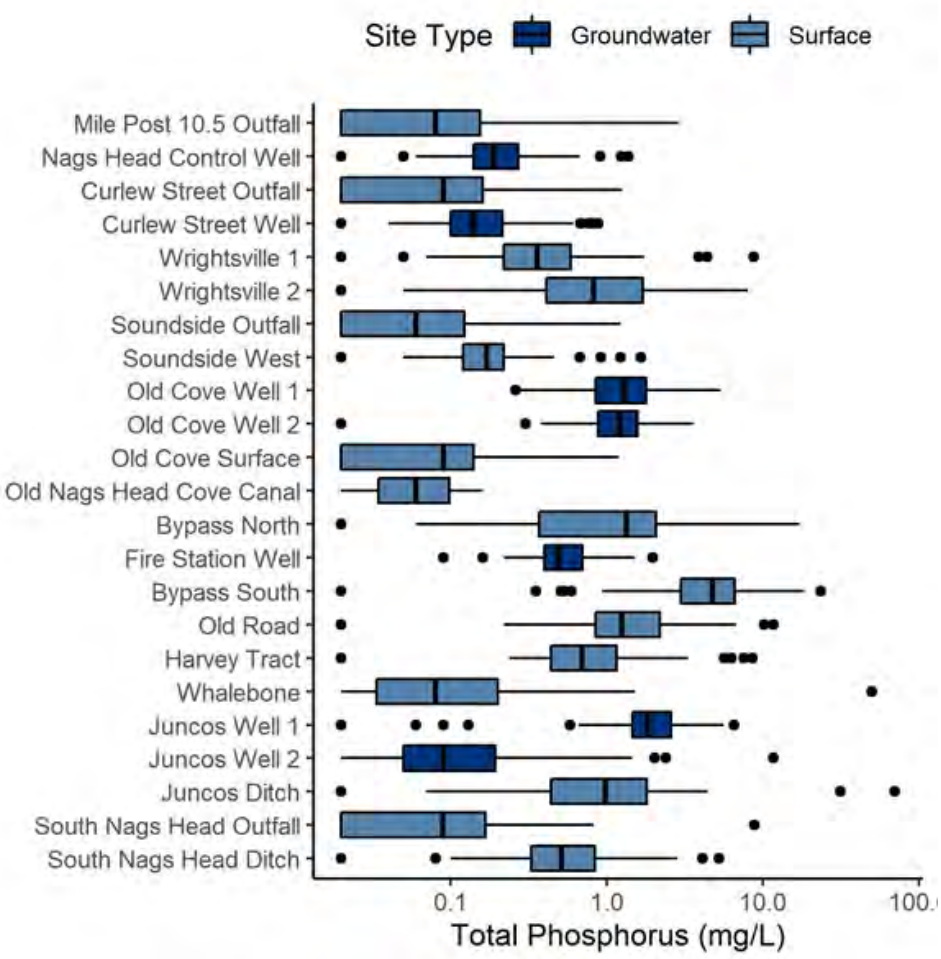


Figure 7-6. TP concentrations across surface water and groundwater in Nags Head.

In Figure 7-6, the boxplots represent concentrations across sampled dates from 2011-2020. Sites are organized from north to south.

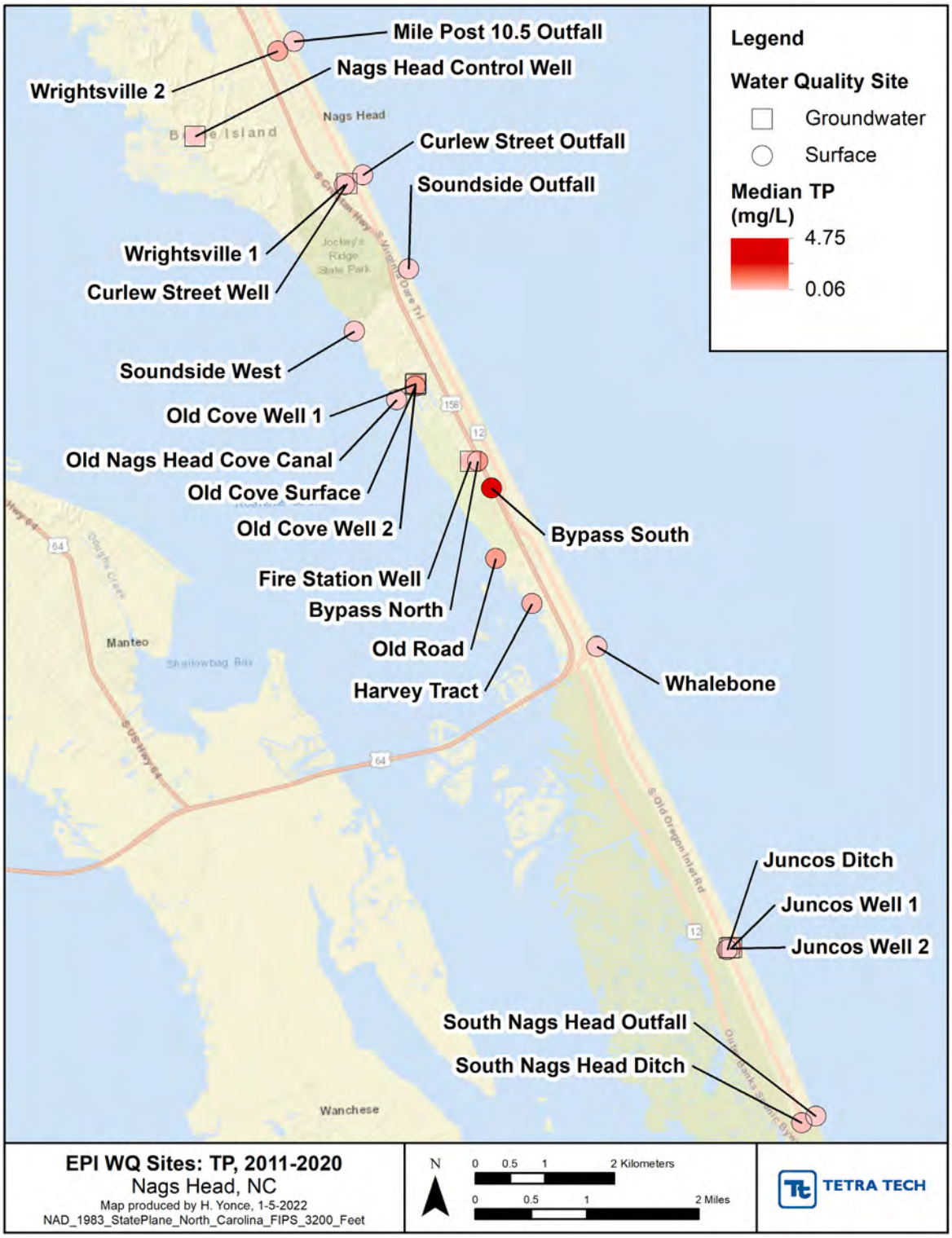


Figure 7-7. Observed TP median concentrations (2011-2020)

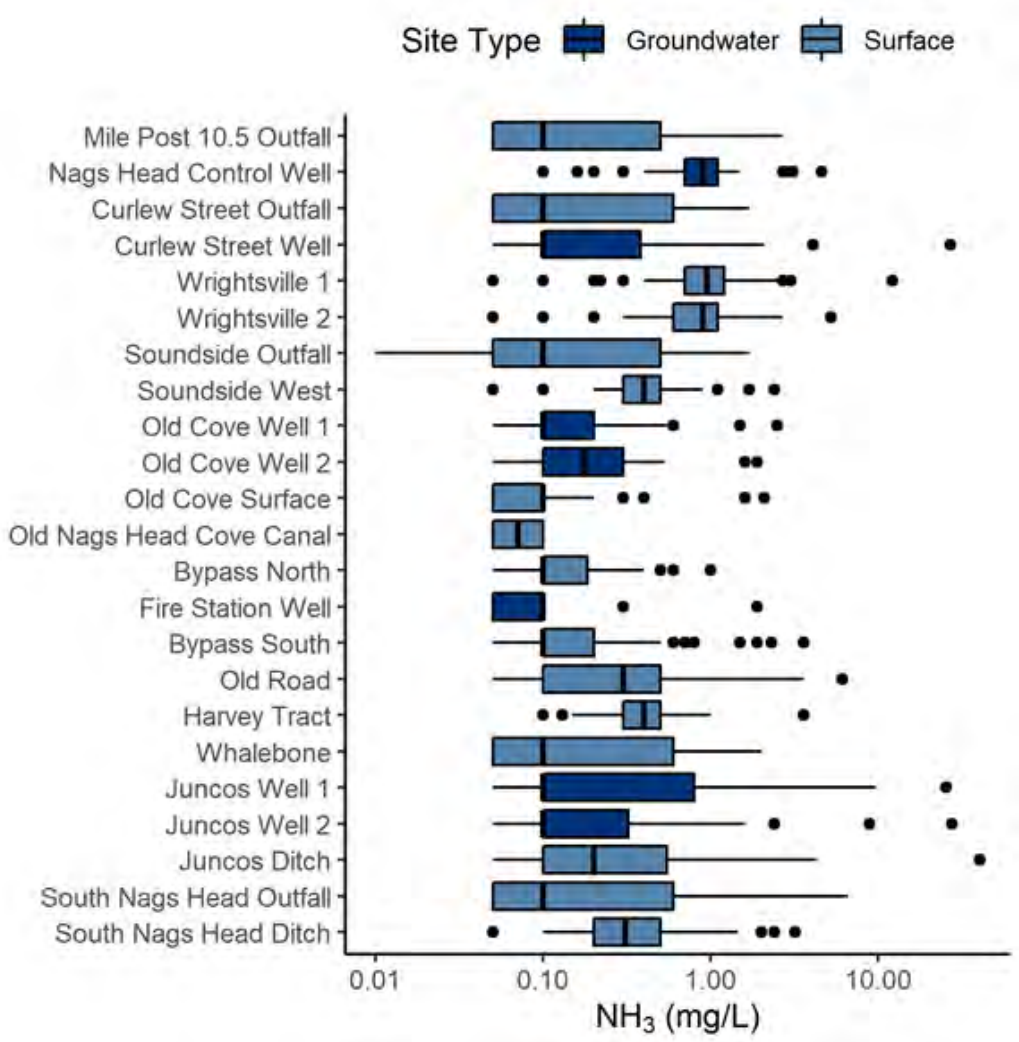


Figure 7-8. NH_3 concentrations across surface water and groundwater in Nags Head.

In Figure 7-8 the boxplots represent concentrations across sampled dates from 2011-2020. Sites are organized from north to south.

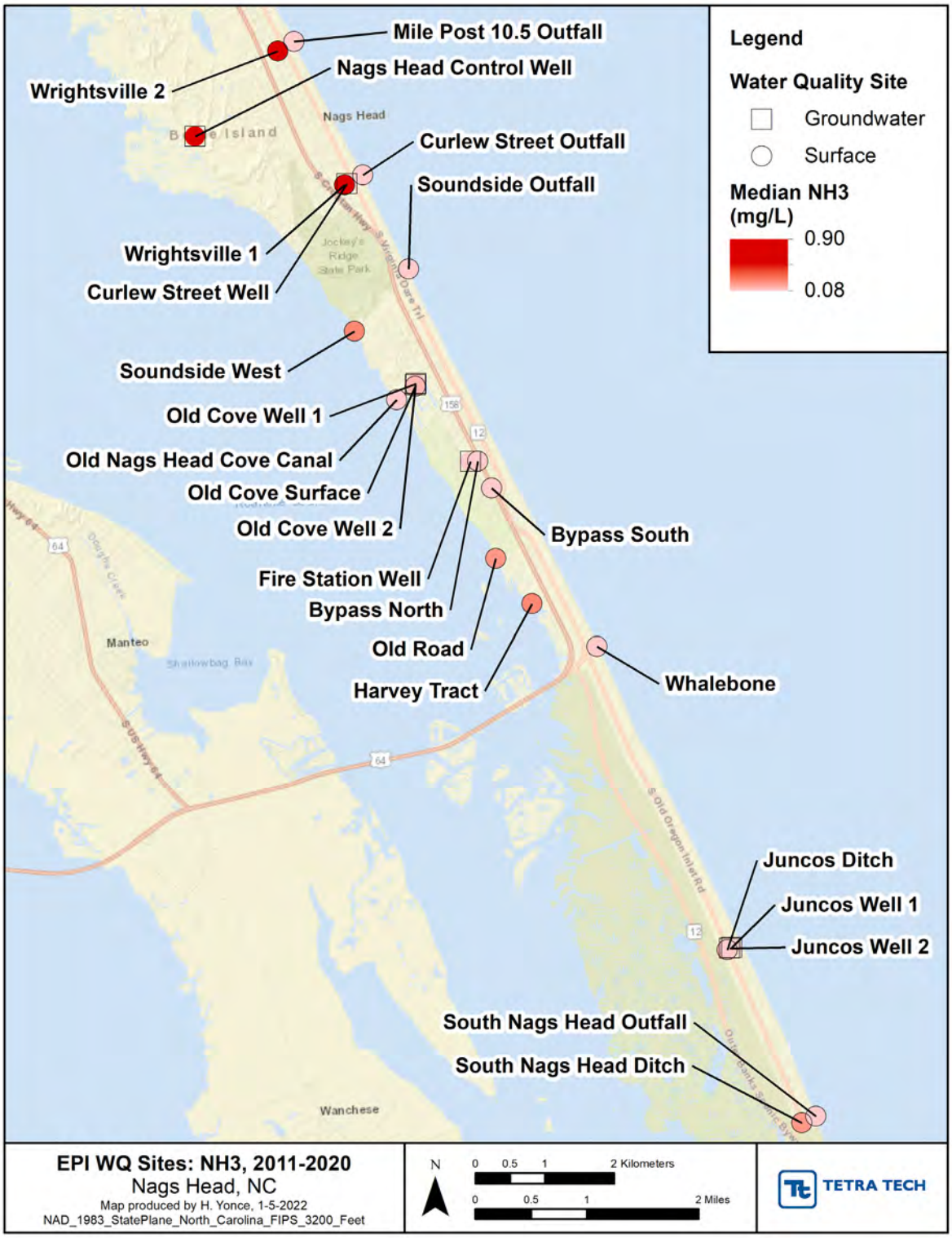


Figure 7-9. NH_3 Median Concentrations (2011-2020)

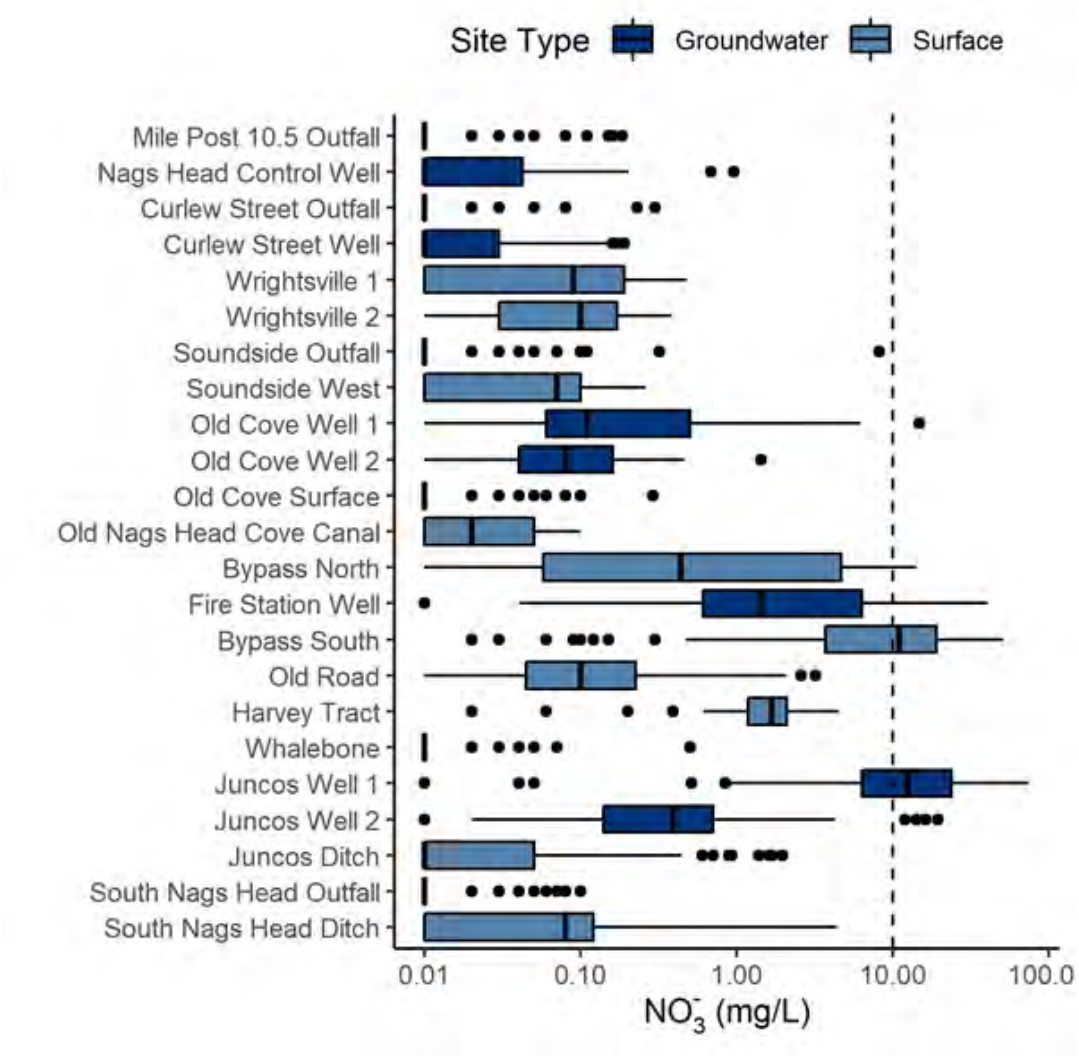


Figure 7-10. NO_3^- concentrations across surface water and groundwater in Nags Head.

In Figure 7-10, the boxplots represent concentrations across sampled dates from 2011-2020. Sites are organized from north to south. Dotted line represents the North Carolina water quality standard of 10 mg/L.

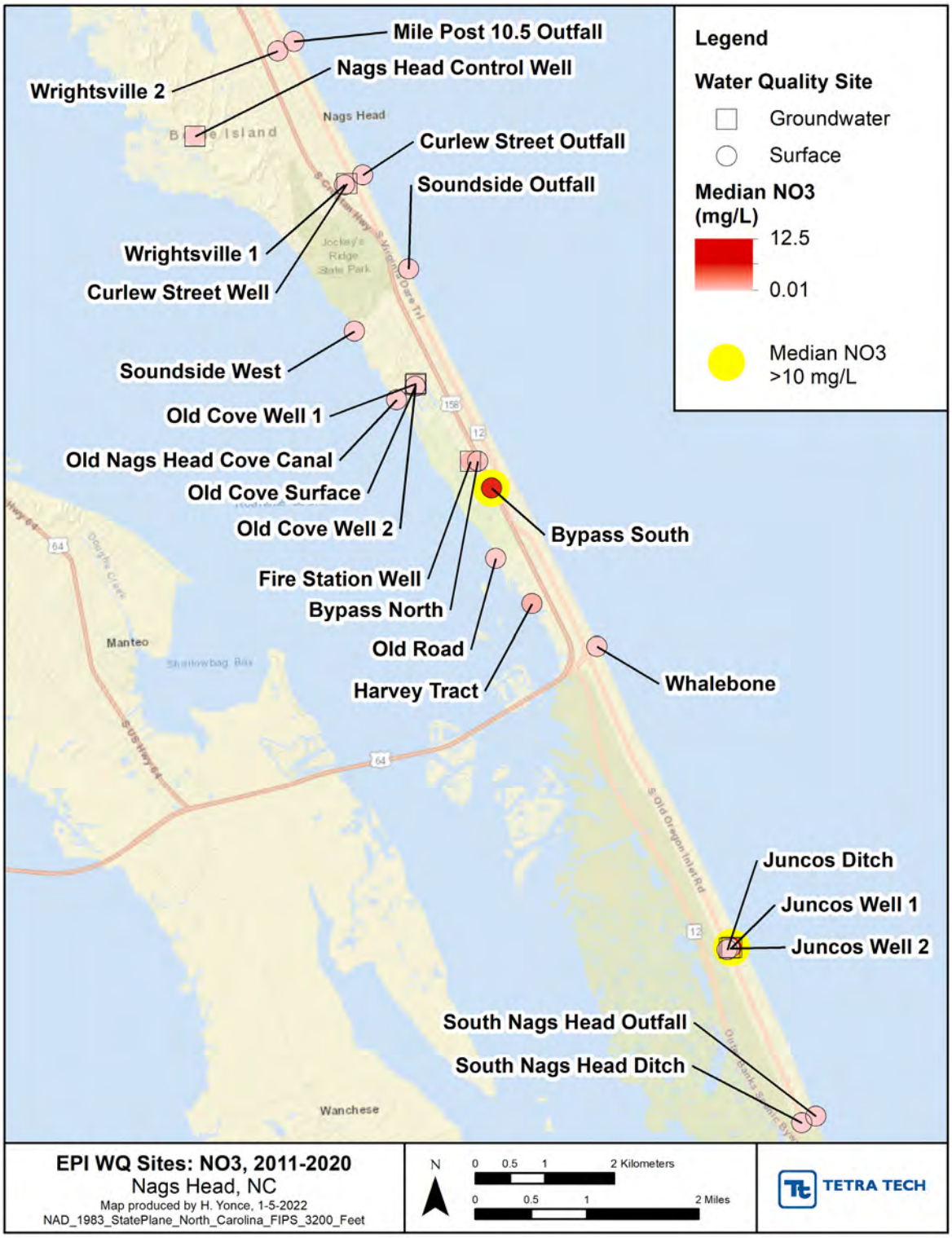


Figure 7-11. Observed NO_3^- median concentrations (2011-2020)

Water quality was variable across surface and groundwater sites and across indicators. Two sets of indicators suggested sites with elevated water quality issues that may serve as targets for decentralized wastewater improvements in the future. The Bypass South surface site and the Juncos Well 1 groundwater site were flagged as high NO_3 sites, where both sites had median NO_3 concentrations exceeding 10 mg/L.

To obtain a better gauge of watershed health, increasing surface water quality sample collections from monthly to weekly would greatly increase the overall statistical sample sets. This would allow staff to obtain a large baseline data set and seasonal data sets to understand normal variations in water quality and bacteria levels. The data could also be correlated to precipitation events, high and king tides, and hurricanes. The data collected should focus on Nitrate Nitrogen (NO_3^-) for water quality as these are the primary indicators to septic failures. Enterococci is specifically utilized for beach closures. Data would need to be collected on a more frequent basis to determine if outlier data is in exceedance of a set Nags Head Watershed specific levels and if there is a septic system failure in close proximity to a water quality sampling station, potential central sanitary sewer overflow from other NPDES permitted wastewater treatment systems, or from a natural pattern. In addition, six (6) additional sample locations have been identified near areas with 7-feet or less above MSL and with groundwater tables closer to the surface. These sites were selected to provide better coverage to gain a clear understanding of water quality levels.

7.4.2 Bacteria In Surface Water and Groundwater

Enterococci were sampled regularly in surface waters from 2011-2020 and sporadically in groundwater sites. Concentrations were compared to the Environmental Protection Agency (EPA)'s recreational water quality criteria recommendations (U.S. Environmental Protection Agency, 2012), which include a geometric mean of 35 colonies/100 mL and a statistical threshold value (90^{th} percentile) of 130 colonies/100 mL. Note that the locations sampled in Nags Head are not necessarily designated for primary contact recreation; thus, the comparison to the geometric mean and 90^{th} percentile may not be applicable for assessment purposes but may serve as a useful point of reference. Exceedances of the Enterococci criteria (geometric mean and 90^{th} percentile) occurred in most surface sites and were more common in soundside sites.

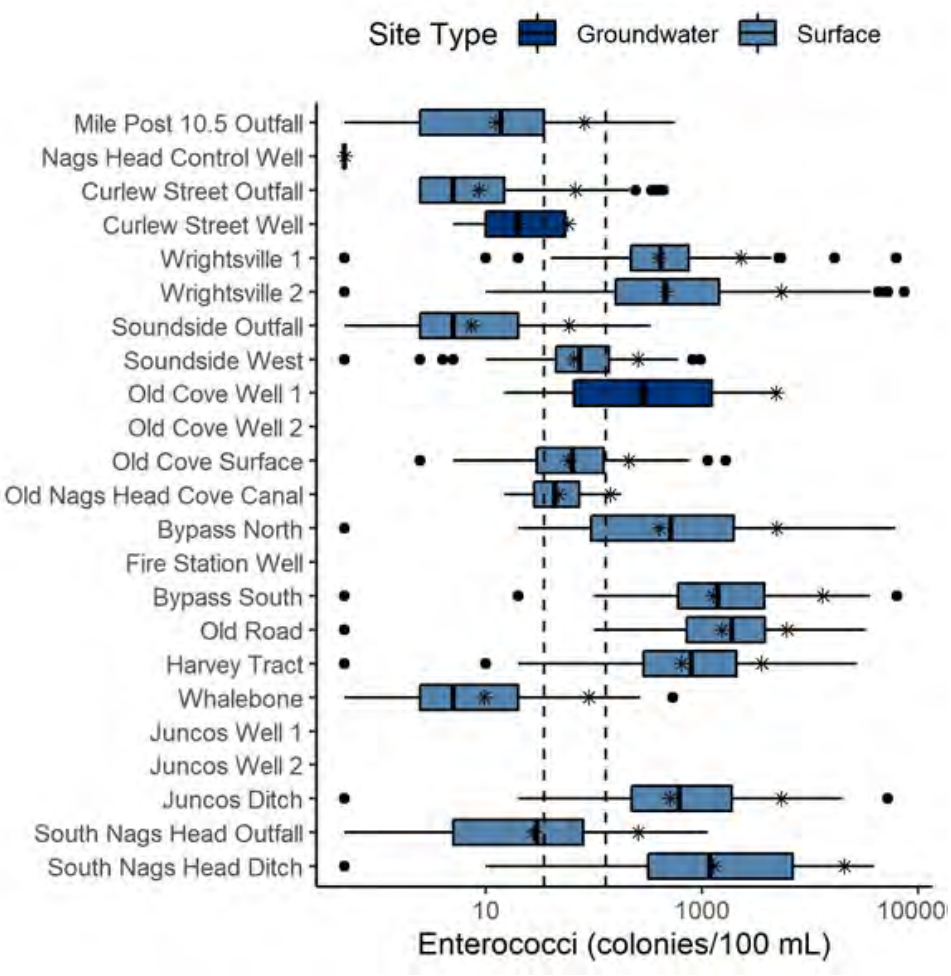


Figure 7-12. Enterococci concentrations across surface water and groundwater in Nags Head.

In Figure 7-12 the boxplots represent concentrations across sampled dates from 2011-2020. Stars represent the computed geometric mean and 90th percentile for each site. Sites are organized from north to south. Dotted lines represent EPA's recreational water quality criteria recommendations of a geometric mean of 35 colonies/100 mL and a statistical threshold value (90th percentile) of 130 colonies/100 mL.

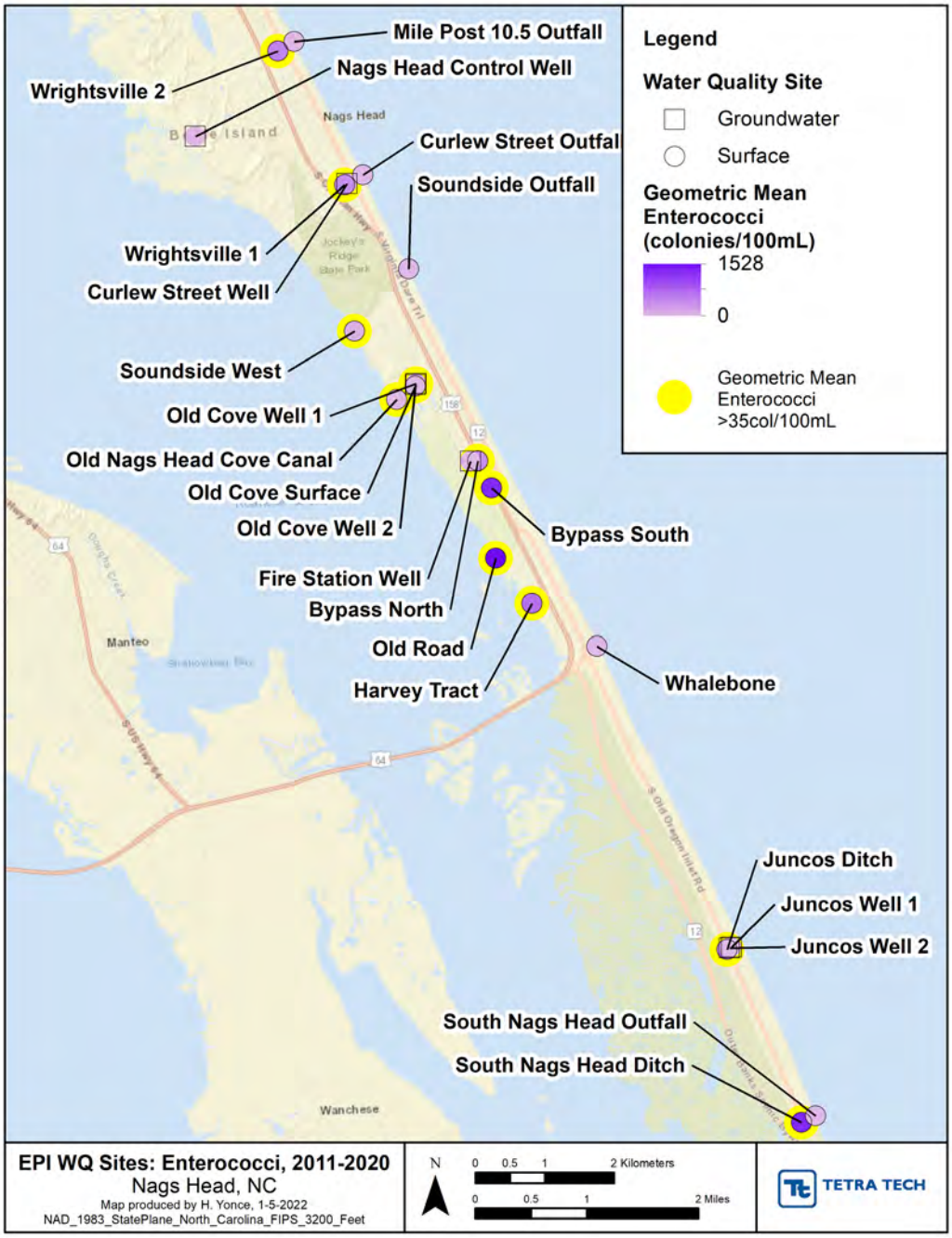


Figure 7-13. Observed Enterococci geometric mean concentrations across Nags Head (2011-2020)

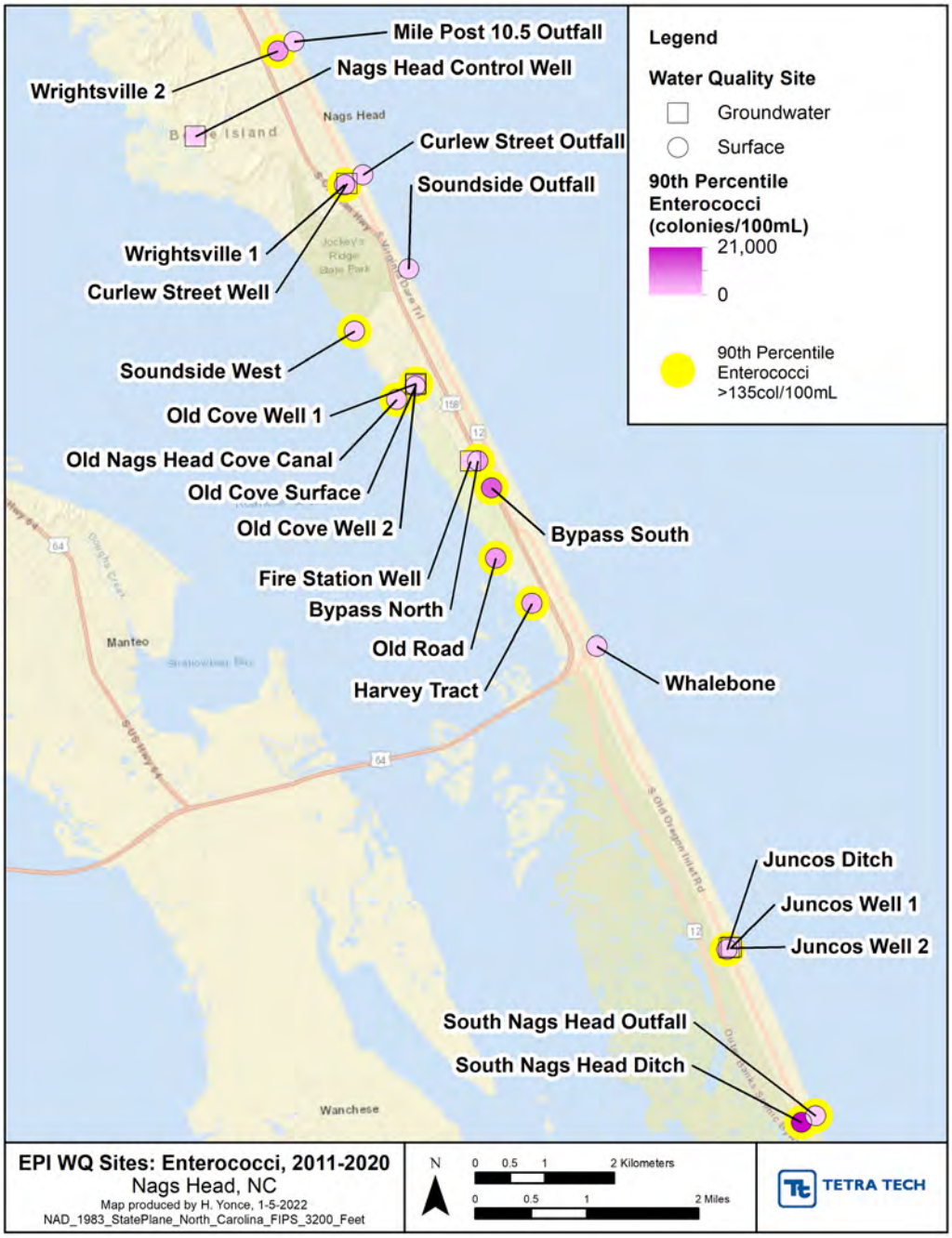


Figure 7-14. Enterococci 90th percentile concentrations across Nags Head (2011 to 2020)

E. coli were sampled regularly in surface waters and groundwater from 2011 to 2020. Concentrations were compared to the Environmental Protection Agency's recreational water quality criteria recommendations (U.S. Environmental Protection Agency, 2012), which include a geometric mean of 126 colonies/100 mL and a statistical threshold value (90th percentile) of 410 colonies/100 mL. Note that the locations sampled in Nags Head are not necessarily designated for primary contact recreation; thus, the comparison to the geometric mean and 90th percentile may not be applicable for assessment purposes

but may serve as a useful point of reference. Exceedances of the *E. coli* criteria were common in surface water sites but not observed in groundwater sites. In surface water sites, geometric mean values exceeded the standard at Mile Post 10.5 Outfall, Soundside Outfall, Old Road, Harvey Tract, and South Nags Head Ditch. 90th percentile values exceeded the standard at all surface sites except Old Nags Head Cove Canal.

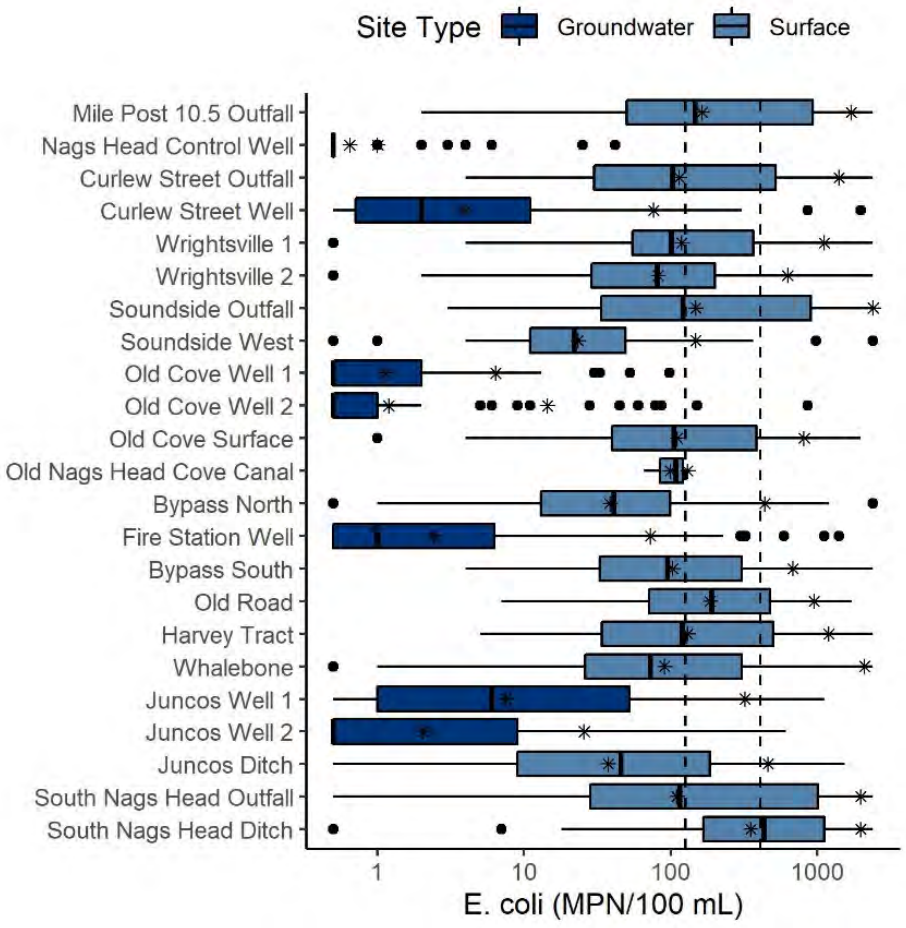


Figure 7-15. *E. coli* concentrations across surface water and groundwater in Nags Head.

In Figure 7-15, the boxplots represent concentrations across sampled dates from 2011 to 2020. Stars represent the computed geometric mean and 90th percentile for each site. Sites are organized from north to south. Dotted lines represent EPA's recreational water quality criteria recommendations of a geometric mean of 126 colonies/100 mL and a statistical threshold value (90th percentile) of 410 colonies/100 mL.

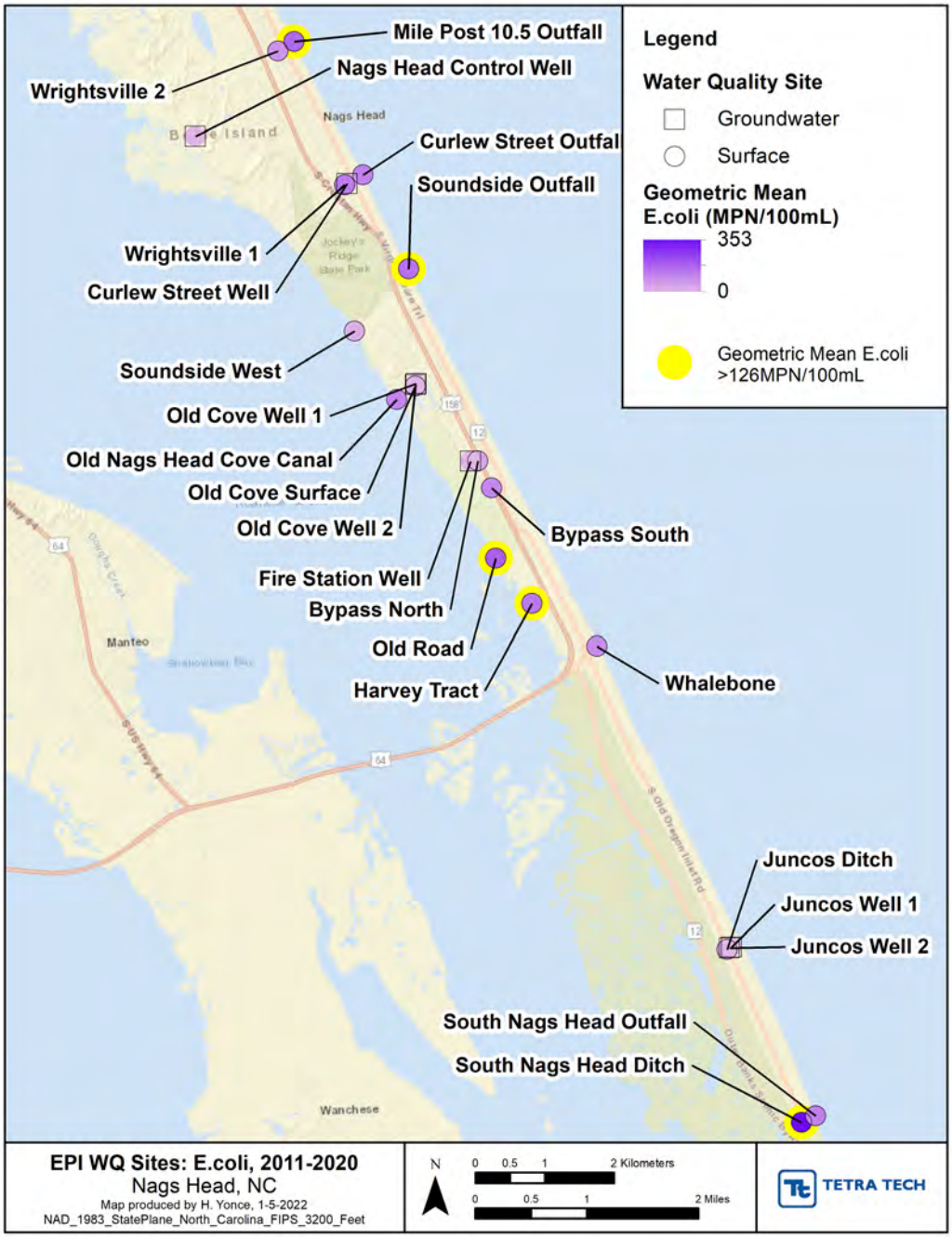


Figure 7-16. *E. coli* geometric mean concentrations across Nags Head (2011-2020)

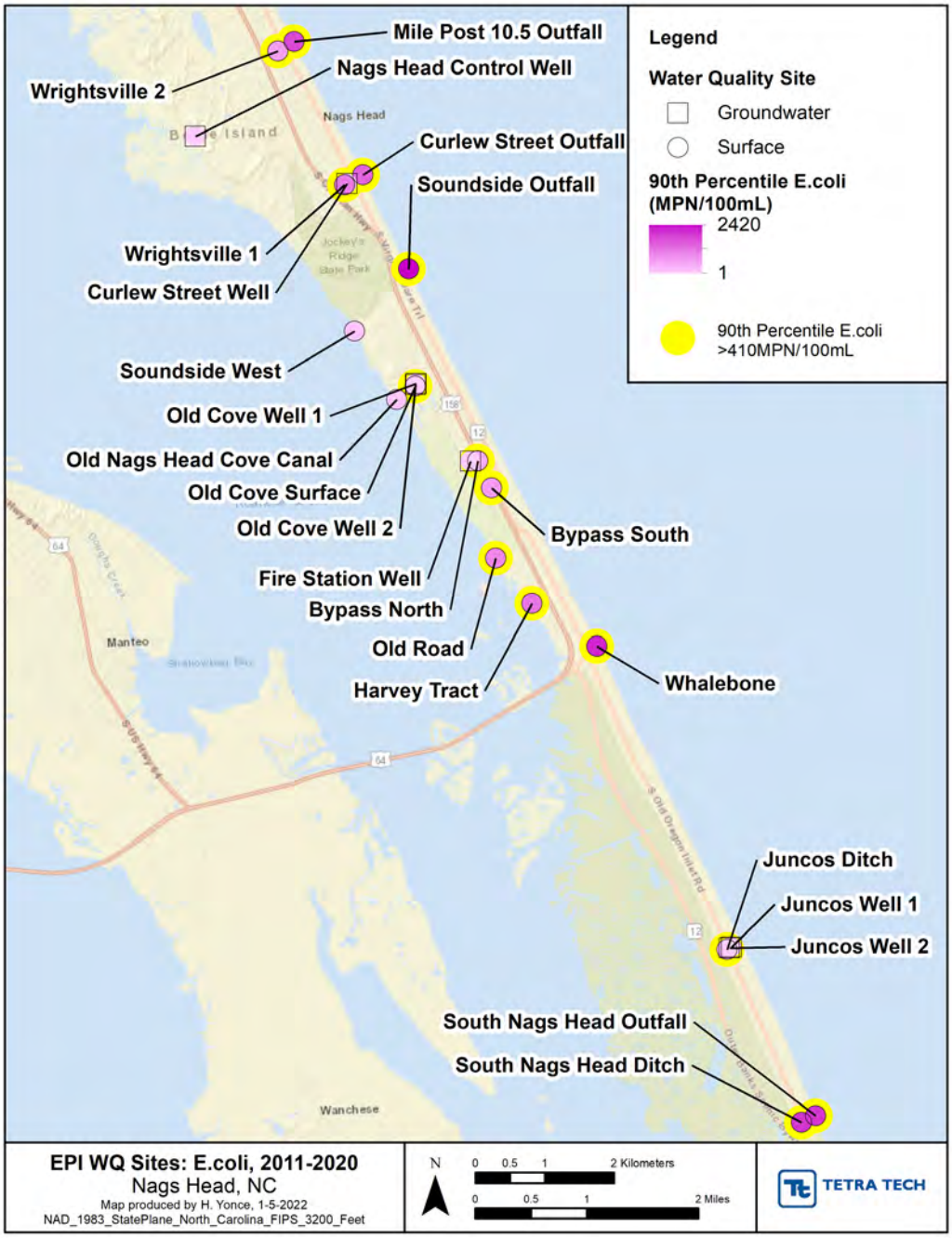


Figure 7-17. *E. coli* 90th percentile concentrations across Nags Head (2011-2020)

Combined bacterial indicators of Enterococci and *E. coli* showed that all surface sites had an exceedance of the 90th percentile EPA values for either or both metrics, whereas no groundwater sites were flagged for these indicators.

To obtain a better gauge of watershed health, it is recommended that the town focus on obtaining only Enterococci bacteria and increasing the number of samples to correlate with additional water quality samples as noted above in Section 7.4.1. Switching to just Enterococci sampling is due to the fact that

Enterococci is the primary indicator to septic failures and is specifically utilized as an indicator for beach closures.

7.5 Program Database Framework

To compile the Plan, Tetra Tech undertook a data compilation, aggregation, and synthesis effort which encompassed collecting data from disparate sources, reconciling various differences in formatting, record keeping, and nomenclature, and joining data in time and space. This effort resulted in several recommendations for future town activities to access, compile, and analyze information in an efficient manner that would provide significant benefit to the town. These recommendations include:

1. **Compile and maintain data streams in centralized locations.** Many of the data sources relevant to decentralized wastewater management are generated on monthly, yearly, or sporadic intervals, so maintaining a workflow to compile these data into a single data sheet will enhance the accessibility of these data sources. Incoming data can be added to existing datasets to ensure data compatibility and best practices.
2. **Organize data in "star schema."** Given the several streams of relevant data sources that have disparate formatting, compiling all data in a single spreadsheet is not feasible to maintain or track. Rather, we recommend that data streams be maintained as separate spreadsheets that can be linked through a single metadata table that contains information about how to connect spatial aspects between datasets (e.g., unique parcel PINs).
3. **Standardize spatial information that is common within and across datasets.** Spatial information that can be spelled or capitalized differently (e.g., addresses) should be standardized with a common format so that information for a given location can be linked both across time within a dataset and across datasets. This process should be automated as much as possible to reduce the capacity for human error.
4. **Identify and correct where parcel, address, and resident information do not match.** In some cases, such as when a given parcel/address has multiple units and thus multiple residents, further discussion should be made about how to link and interpret data arising from the different sources of spatial information (e.g., water use data by parcel vs. tax information by resident).

The basis of an updated program database framework starts with a complete list of all town parcels, identified by unique PIN. Key data sources were compiled to the extent possible for this DWMP update, but there is a significant need for conducting Quality Assurance / Quality Control of this data aggregation.

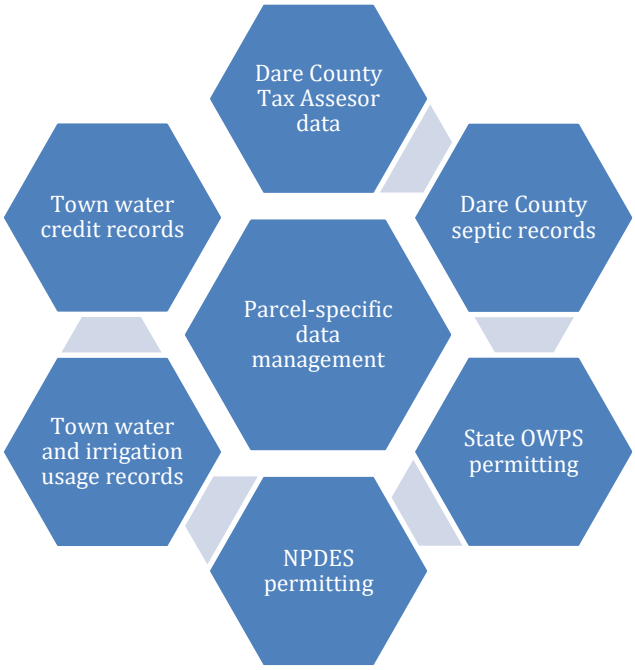


Figure 7-18. Schematic diagram for the master database framework

7.6 New and Expanded Initiatives

As the town expands the DWMP and SHI Program, a more formalized program management model, Voluntary Septic System Subscription Service, and additional public education and outreach tools should be added to the program. The management model would provide the town with additional septic system maintenance guidance and the voluntary septic system subscription service would provide homeowners with added value in addition to the current SHI Program. The voluntary septic system subscription service would focus on regular management, operation, and maintenance, with a greater emphasis on the goal to improve water quality. The additional public education and outreach can be provided to homeowners, businesses, and visitors to improve proactive septic system maintenance and improve water quality.

7.6.1 Future Program Management Model Framework

A good example of a basis to build a more robust DWMP is the U.S. Environmental Protection Agency (EPA) Voluntary National Guideline for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems.[22] The EPA guideline provides detailed septic system management models and a framework for a local and county governments to follow. Below is an excerpt from the guidelines:

> **Management Model 1** - "Homeowner Awareness" specifies appropriate program elements and activities where treatment systems are owned and operated by individual property owners in

[22] US EPA Voluntary National Guideline for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems, March 2003, p. 5

areas of low environmental sensitivity. This program is adequate where treatment technologies are limited to conventional systems that require little owner attention. To help ensure that timely maintenance is performed, the regulatory authority mails maintenance reminders to owners at appropriate intervals.

Management Model 2 - “Maintenance Contracts” specifies program elements and activities where more complex designs are employed to enhance the capacity of conventional systems to accept and treat wastewater. Because of treatment complexity, contracts with qualified technicians are needed to ensure proper and timely maintenance.

Management Model 3 - “Operating Permits” specifies program elements and activities where sustained performance of treatment systems is critical to protect public health and water quality. Limited-term operating permits are issued to the owner and are renewable for another term if the owner demonstrates that the system is in compliance with the terms and conditions of the permit. Performance-based designs may be incorporated into programs with management controls at this level.

Management Model 4 - “Responsible Management Entity (RME) Operation and Maintenance” specifies program elements and activities where frequent and highly reliable operation and maintenance of decentralized systems is required to ensure water resource protection in sensitive environments. Under this model, the operating permit is issued to an RME instead of the property owner to provide the needed assurance that the appropriate maintenance is performed. This model is good for decentralized cluster systems.

Management Model 5 - “RME Ownership” specifies that program elements and activities for treatment systems are owned, operated, and maintained by the RME, which removes the property owner from responsibility for the system. This program is analogous to central sewerage and provides the greatest assurance of system performance in the most sensitive of environments.

As the DWMP evolves, the town should continue to move towards a management model that builds upon existing efforts under the SHI involving proactive maintenance, education, and outreach. This may be in the form of a combination of US EPA models 1, and 2 as well as a portion of model 3.

7.6.2 Voluntary Septic System Subscription Service Program

Through the stakeholder interviews, public forum meeting, and results from the community questionnaire, many homeowners were unable to recall when they last inspected or pumped out their septic systems. Overall, homeowners felt a heavy burden regarding the proper maintenance of their septic system. Specifically, they were unsure of the components of their systems and how to proactively maintain them.

Development of a voluntary septic subscription service would automate the inspection and maintenance of septic systems on a reoccurring basis and would transfer the burden of septic system maintenance from the homeowner to the town. The specific legal and operational details of such a system are beyond the scope of the Plan. It is recommended that the town create a committee to develop recommendations on the organization and operational details of the voluntary septic system subscription service.

The voluntary septic system subscription service program could provide similar services under the SHI but would do so without any action of the homeowner beyond agreeing to participate in the subscription program and paying any annual subscription fees to be determined by the town.

Items included in the voluntary septic system subscription service program may include:

- Inspections at routinely scheduled intervals
- Pump outs at routinely scheduled intervals or as needed based on inspection results
- Additional loan or grant opportunities for system replacement

Additionally, the voluntary septic system subscription service program could stand as an addition or replacement of the current SHI with similar services but scaling up proactivity to a larger service population with a sustainable revenue model. The program could be organized as a town service, utility, or as a nonprofit organization supported by the town.

The voluntary septic system subscription service program could also be used as a model and replicated by other towns with their own revenue/support models or be implemented through a regional partnership. This program could offer communities an opportunity to protect water quality through proactive septic system inspections, pump outs, and replacements at a level not seen with the current SHI model or with the SHI expanded initiatives outlined and recommended in this report.

For the development of a voluntary septic system subscription service, the program may be broken into several phases. Below is an example of phases that could be executed under this new program element and further refined by a committee:

Phase 1: Develop a three-year pilot program with a small subset of homes to test program. Identify homes in target areas with MSE of 7-feet or lower, high groundwater tables, and poor water quality. Also, consider the age of home and type of existing system (conventional and/or bottomless tank). Coordinate with homeowners to conduct inspections, pump outs, and replacement of systems (as needed).

Identify grants to assist with program needs and/or septic system replacement. Additional information on grants, loans, and funding is outlined in Section 11.2 Grants and Loans.

Potential grant/funding opportunities include:

1. American Rescue Plan Act (ARPA) and Infrastructure Act Monies
2. FEMA Building Resilient Infrastructure and Communities (BRIC)
3. NC Land and Water Fund (LWF)
4. NC DEQ 319(h) Grant
5. NC DEQ Division of Water Resources grants

Program includes:

1. Scheduled annual septic system inspection
2. Reviewing inspection results in greater detail
3. Free pump out every three (3) years
4. Potential increased loans and grants to replace septic systems

Phase 2: Roll out full program to all homeowners. Modify as needed based on test program.

7.6.3 Public Education and Outreach

Through the perceptions document reviews and stakeholder interviews, additional education came up in nearly all reports and discussions as a need for the SHI program.

To meet the needs of new homeowners and educate existing homeowners on proper septic system maintenance, an increase in outreach and education is needed under the SHI. This can be done through a variety of media platforms including links and information posted on the town webpage, mailer/flyers, social media, advertisements on tv, radio, internet spots, and pre-roll movie ads using a PSA format. In addition, free giveaways like grease can lids, bathroom mirror clings, or sink signs can be provided in a welcome packet to new homeowners.

Figure 7-19. Giveaway and education materials

Giveaways:

- Citizen Science water quality testing program
- Toilet flapper giveaway/rebate
- Grease can lids
- Vinyl mirror clings for what to flush/hotel cards

Education:

- WWTP Individual Permit Report – how to read/interpret reports
- Hot spot focused outreach/flyers
- Water quality fair – vendors, outreach, education, demo, stormwater, LID
- EPA Septic Week- 3rd week in September
- YouTube Septic System and Water Quality PSA Videos
- Social Media Posts
- Collaboration with State and National Parks, The Nature Conservancy at Nags Head Woods, Jockey's Ridge, and additional stakeholders NCCF and APNEP for education and outreach
- Residential Rain Garden flyers and information

Services:

- Voluntary Septic System Subscription Service – more education targeted to subscribers

Program Practices:

- Grants for Septic and Water Quality – see Section 11.2 Grants and Loans
- Continuous water quality testing via remote sensors with education via town website and/or voluntary monitoring program to aid in testing collection
- Provide Septic System Landscape/Planting Information

7.7 Recommendations and Action Items

To strengthen the Septic Health Initiative, programmatic items have been expanded with actions and annual goals. While the goals are targets for staff to achieve; budget, staff time, and homeowner requests may change the actual outcomes of each action.

Moving forward it is crucial to monitor progress toward the plan's goals. Town staff should review progress on an annual basis, at minimum, and provide a report to the Board of Commissioners. The Board of Commissioners can then use the updates and remaining actions in setting priorities for implementation during each budget cycle. Continuous review ensures that the budget accounts for plan implementation needs, that responsible parties are identified, resources are allocated for success, and priorities are achieved in appropriate time frames. In addition, to maintain the plan's currency in the long term, the town should undertake a major re-evaluation and update of the DWMP, at least, every ten years.

Below is a list of summarized recommended actions for the SHI program and also in the table below:

1. Set a goal of completing 500 septic system inspections annually by FY2027
2. Set a goal of 250 septic system pump outs rebated annually by FY2027
3. Increase the septic system pump out rebate from $45 to $150
4. Increase septic system repair/replacement maximum loan amount from $7,500 to $12,000
5. Increase education through a variety of materials, media sources, and giveaways
6. Increase water quality testing and groundwater monitoring with the purchase of remote loggers
7. Develop a Voluntary Septic System Subscription Service.
    a. Town to create a committee to develop the organization and operational details of the Voluntary Septic System Subscription Service or Voluntary Septic Utility, including service levels, manner of organization, and revenue sources
    b. Phase the rollout of the service to ensure feasibility
8. Identify and apply for grants to assist with program needs and/or septic system replacement
9. Evaluate and update the DWMP, at least every ten (10) years

The water quality and bacteria samples are beneficial indicators of potential septic effluent mixing with groundwater and surface water.

Water quality was variable across surface and groundwater sites and across indicators. Two sets of indicators suggested sites with elevated water quality issues that may serve as targets for decentralized wastewater improvements in the future. The Bypass South surface site and the Juncos Well 1 groundwater site were flagged as high NO_3 sites, where both sites had median NO_3 concentrations exceeding 10 mg/L. Combined bacterial indicators of Enterococci and *E. coli* showed that all surface sites had an exceedance of the 90th percentile EPA values for either or both metrics, whereas no groundwater sites were flagged for these indicators.

To obtain a better gauge of watershed health, increasing surface water quality sample collections from quarterly and monthly to weekly and increasing bacteria samples from quarterly to monthly would greatly increase the overall statistical sample sets. This would allow staff to obtain a large baseline data set and seasonal data sets to understand normal variations in water quality and bacteria levels. The data could also be correlated to precipitation events, high and king tides, and hurricanes. The data collected should focus on Nitrate Nitrogen (NO_3^-) for water quality and Enterococci for bacteria as these are the primary indicators to septic failures. Enterococci, specifically, is utilized for beach closures. Data would need to be collected on a more frequent basis. This could determine if outlier data is in exceedance of a set Nags Head Watershed specific levels and if there is a septic system failure in close proximity to a water quality sampling station, if there is a potential central sanitary sewer overflow from other NPDES permitted wastewater treatment systems, or if the issue is due to a natural cause. In addition, six (6) additional sample locations have been identified near areas with 7-feet or less above MSL and with groundwater tables closer to the surface. These sites were selected to provide better coverage to gain a clear understanding of water quality levels.

To gain a larger understanding of water quality and bacteria additional data collection is recommended.

1. Increase water quality testing weekly throughout the year and focus on Nitrate Nitrogen (NO_3^-) which is a key indicator of septic effluent.
2. Increase bacteria testing weekly throughout the year and focus on Enterococci. This is the indicator used for beach closures.
3. Purchase six (6) remote water quality data loggers.
4. Below is a map of additional locations to gain a better spread of data across Nags Head. Add 6 water quality testing locations in areas identified with low MSL at the following locations:
    1) Huron Street
    2) Hargrove Street at the Beach Access
    3) East Hunter Street
    4) Jockey's Ridge East
    5) Colony Drive North
    6) East Surfside Street
5. Analyze water quality and bacteria sampling data annually to understand changes to water quality and determine if nay programmatic changes are needed for the SHI

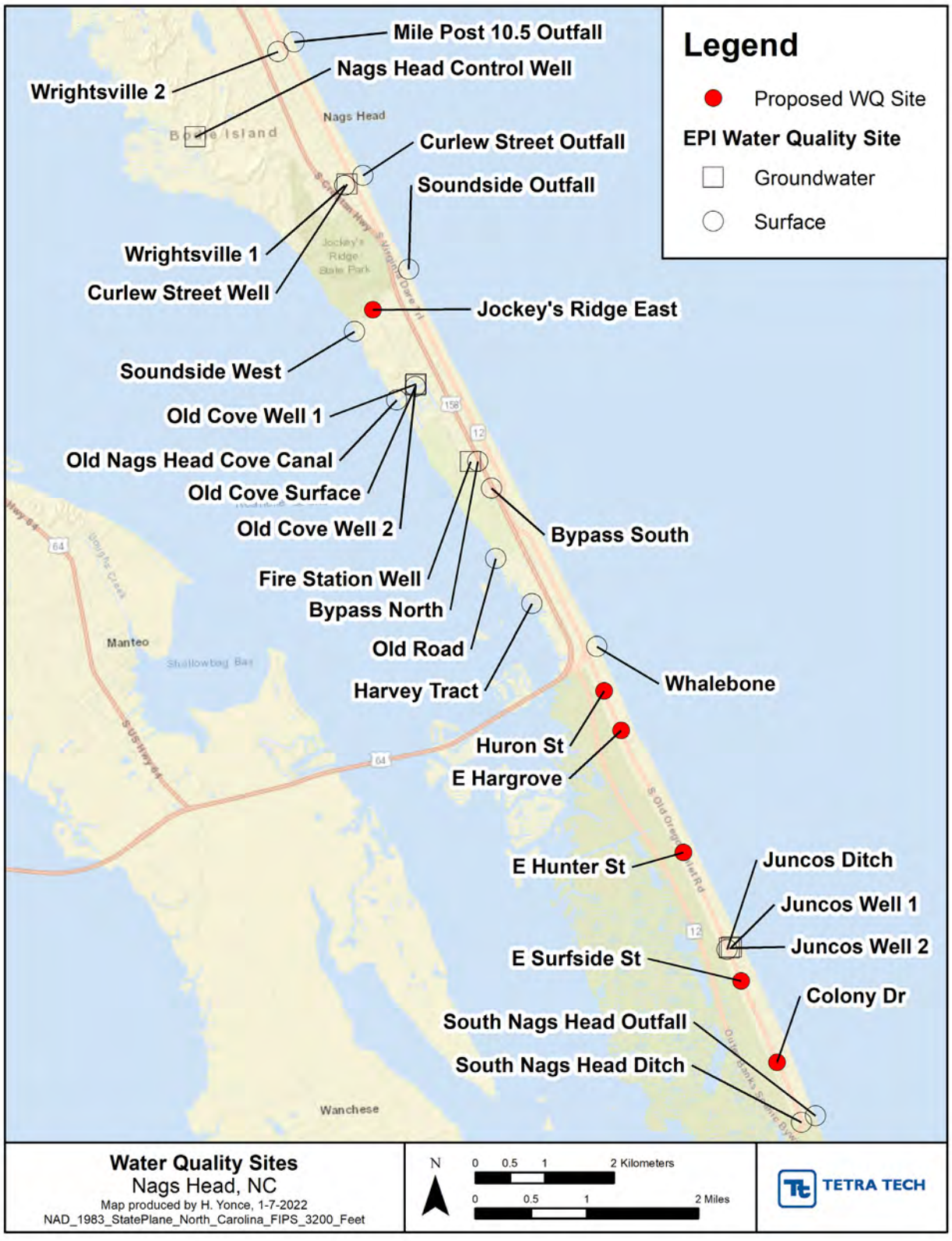


Figure 7-20. Map of Additional Water Quality Monitoring Locations shown in Red

Table 7-2. DWMP and Todd D. Krafft Septic Health Initiative Programmatic Actions

Item	Action Item	Goal
Septic System Inspection	Increase septic system inspections	Increase septic systems inspections from 150 to 500 incrementally over a 5-year period
Septic Tank Pump Out Rebate	Increase pump out rebate/water bill credit amount from $45 to $150 (approx. ½ cost of pump out)	Increase rebate credits from 30 to 250 incrementally over a 5-year period
Septic Loan	Increase max. loan amount from $7,500 to $12,000	Provide 5 septic system repair/replacement loans annually
Water Quality and Bacteria Testing	1. Increase frequency for both water quality and bacteria sampling 2. Sample only for NO_3^- and Enterococci. No longer sample for phosphorus and other bacteria 3. Add six (6) water quality sampling locations 4. Purchase six (6) remote water quality loggers	Conduct Nitrate Nitrogen (NO_3^-) and Enterococci samples weekly
Groundwater Remote Data Loggers	1. Continuously log groundwater levels at key locations 2. Add ten (10) groundwater wells 3. Purchase ten (10) remote groundwater data loggers	Install 10 new wells with remote groundwater monitoring stations
Education	Expand septic and water quality education to homeowners, renters, and visitors	Increase SHI program impressions and program participation via town webpage, social media, tv and radio spots, pre-roll PSA animations/videos at movie theaters, articles in local newspapers and in town's newsletter Nags Head Lines, and via flyers/mailers Provide septic education and SHI program information to realtors and rental agencies Provide water quality data via town webpage and link to other data resources Consider developing a volunteer water quality sampling program
Giveaways	Purchase targeted septic and water quality educational materials to giveaway at festivals and events	Provide 1,000 giveaways annually
Homeowner Welcome Packet	Provide septic and water quality education materials to new homeowners along with SHI program details	Provide 100 packets annually

Voluntary Septic System Subscription Service (see Section 7.6.2)	Create Voluntary Septic System Subscription Service	Obtain 500 subscribers over a 5-year period

SECTION 8.0

Groundwater and Subsurface Water Quality Data and Analysis

8.0 Groundwater and Subsurface Water Quality Data Analysis

As part of the North Carolina Sea Grant, "Climate Change and Onsite Wastewater Treatment System on Coastal Carolinas" project, research is underway by ECU CSI to evaluate existing onsite wastewater technologies under multiple climate conditions in the coastal Carolinas. The intent is to help coastal communities cost-effectively and legally implement climate adaptation plans for wastewater infrastructure.[23] Several publications and presentations have been prepared as part of this research. Below is a summary of a portion of the research, most relevant to the Plan, conducted to determine impacts of groundwater table elevations and subsurface water quality on septic systems.

8.1 Influence of Rising Groundwater on Septic Systems

Rising groundwater tables associated with sea level rise pose a threat to septic systems near the coast. The reason is related to the influence of groundwater levels on the vertical separation distance between the system's drain field and the groundwater table. The majority of septic system treatment occurs in the unsaturated soils beneath the drain field. Aerobic conditions (presence of oxygen) are needed to convert nitrogen and reduce bacteria concentrations. If the drain field soils are saturated with groundwater, soil-based wastewater treatment will be less effective. For these reasons, North Carolina and other states require a vertical separation distance (VSD) between the drain field and the seasonal high-water table. In North Carolina, the requirement for conventional septic systems in sandy soils is 45 cm, or 18 inches. Since drain field lines are typically buried approximately 2 feet deep, this would require the groundwater table to be approximately 3.5 feet or deeper. Permitted septic systems in areas with sufficient groundwater depth can lose their ability to adequately treat wastewater over time if sea level rise results in a rising groundwater table that reduces the vertical separation distance (Figure 8-1). In addition, as sea level rises the distance between the system and the surface water (setback distance) will decrease. Since nutrients and bacteria in wastewater naturally decline in the soils and surficial aquifer, the setback distance also plays a role in reducing potential contaminants prior to discharge to the surface waters. As surface waters get closer to the drain fields, the surface water quality impacts may increase over time.

[23] Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas - North Carolina Sea Grant North Carolina Sea Grant (ncsu.edu)

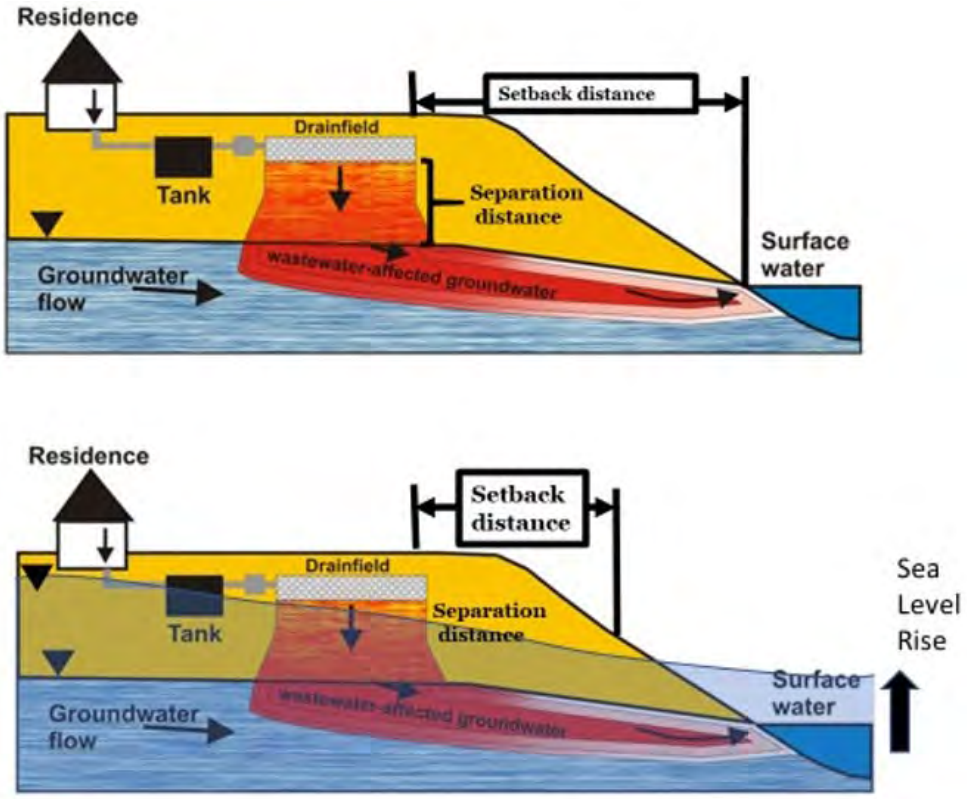


Figure 8-1. Influence of sea level rise and rising groundwater tables on septic systems in coastal settings

8.1.1 Groundwater and Sea Level Monitoring

An analysis of groundwater levels and sea level rise in the Nags Head area was performed utilizing groundwater and sea level rise data obtained from NC DEQ and NOAA, respectively. At Duck, North Carolina, NOAA has been monitoring tidal levels since the 1970s. Their records show that sea level at Duck has been rising approximately 4.8 mm/year or approximately 2 inches/decade from 1978 to 2020 (Figure 8-2). Groundwater levels are currently being monitored by NC DEQ in the surficial aquifer in Dare Co. at eight sites, with data available back into the 1980s (Figure 8-3). As part of the “Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas” research project, several additional groundwater monitoring stations were installed throughout the town to provide additional information on short-term groundwater dynamics and the effects of septic systems on groundwater quality. These sites were located at the Bonnett Street Beach Access, Dowdy Park, the Nags Head Municipal Complex, and a residential site in South Nags Head. In addition, an additional NC DEQ groundwater monitoring well at the Coastal Studies Institute (CSI) in Wanchese was instrumented to provide additional information relevant to sites located in coastal estuarine settings. These sites were instrumented with water level loggers and specific conductivity loggers that recorded every 30 minutes.

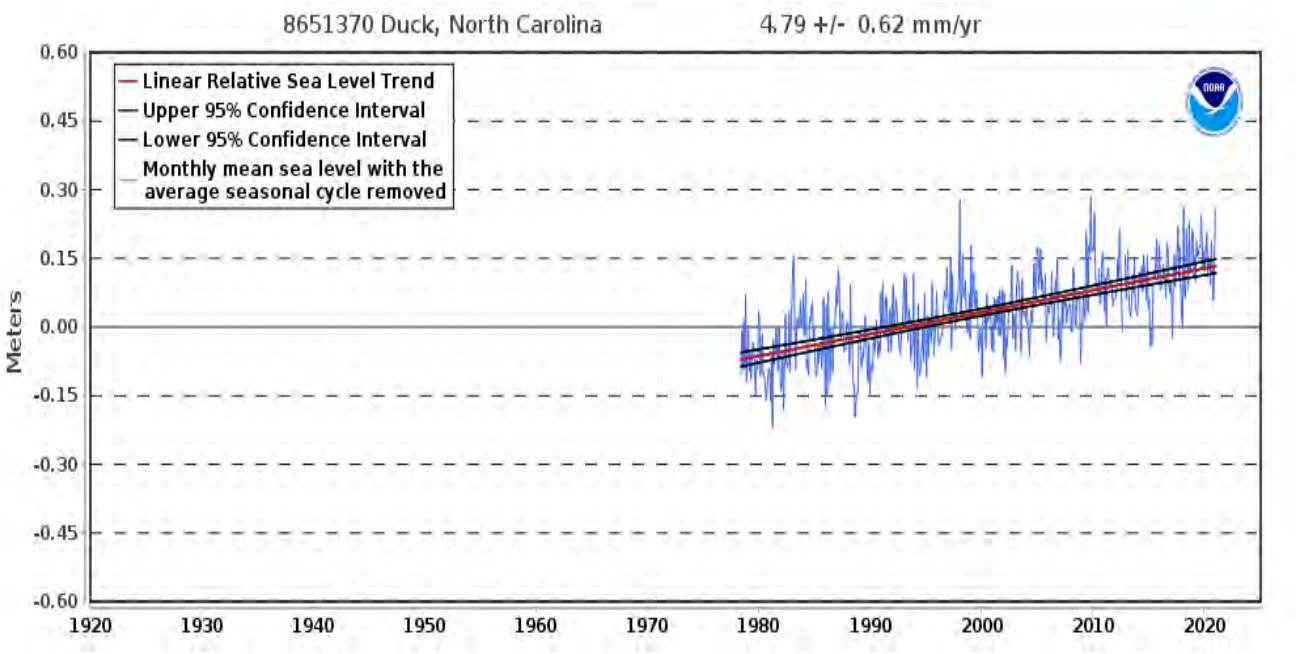


Figure 8-2. Sea level rise measured at the Duck tidal gauge for the record from 1978-2020

Figure 8-3. ECU CSI Groundwater table elevation sampling well data collection sites

Map created by Guy Iverson.

8.1.2 Groundwater Levels

Groundwater levels in Nags Head vary based on the seasonal dynamics of precipitation inputs, evapotranspiration, and ocean and estuary water levels. Typically, groundwater levels will be highest during the winter months, due to lower plant water use and cooler temperatures that result in less evapotranspiration. During warm summer months when evapotranspiration is at a maximum the groundwater levels tend to be the lowest. Shorter term fluctuations of groundwater levels can occur due to storm events, wet weather periods, or extreme events which can cause the groundwater levels to rise several feet. Groundwater may take weeks to months to recede, depending on the elevation, type of soil and the size and intensity of the event. In general, in Dare County (based on NC DEQ surficial aquifer groundwater level data) there is a relationship between land surface elevation and groundwater levels, higher elevation sites tend to have deeper water tables and lower elevation sites that are closer to the ocean or sound tend to have shallower water tables (Figure 8-4). Frontal or primary near the ocean, may have greater ground separation to the water table. Other factors may impact groundwater elevations such as buried layers of peat and organics in the subsurface layers of the soil which may impede groundwater

flow and result in shallower layers of groundwater at some locations. Prolonged storm surge impacts along the oceanfront or sound can result in the propagation of elevated groundwater inland, leading to "sunny day" flooding as supported by the research article entitled "Coastal flooding generated by ocean wave- and surge-driven groundwater fluctuation on a sandy barrier island."[24] In areas where the groundwater table is less than 3.5 feet deep (currently or in the future), conventional septic systems are likely to be unsuitable for adequate wastewater treatment without modification.

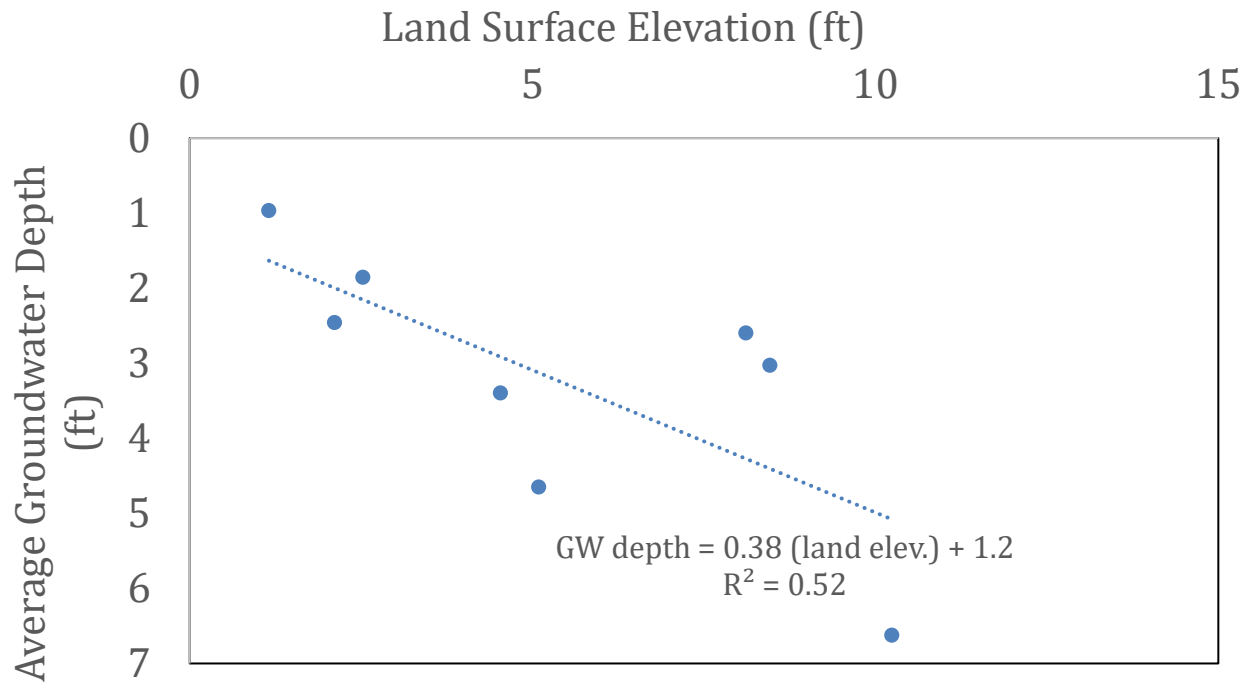


Figure 8-4. General relationship between land surface elevation and surficial aquifer groundwater depth based on average groundwater depths in 8 NC DEQ groundwater wells in Dare County

Data source: NC DEQ available at:
https://www.ncwater.org/?page=537&tl=1&aquifer=&inactive=n&net=&countyname=Dare

This is a broader occurrence that has been observed along the Atlantic Seaboard with evidence of rising groundwater levels noted in various coastal communities from Rhode Island to Florida (Cox et al. 2019, Miami-Dade Water and Sewer Department, 2018, Sukop et al. 2018). The long-term NC DEQ groundwater level data from the 1980s to present suggests that groundwater levels in Dare Co. are rising at a similar or faster rate than sea level rise (Figure 8-5) (median at 5 sites with daily data equal to 11 mm/year (0.433 inches/year) for 2009-2020). Similar observations were made by Cox et al. (2019) in Rhode Island and the authors suggested that water use may also play a role. In cases where water is withdrawn from deeper aquifers, such as in Dare Co., and that water is then discharged to the surficial aquifer (the shallowest aquifer at the surface), this can artificially recharge the surficial aquifer and may

[24] Coastal flooding generated by ocean wave- and surge-driven groundwater fluctuations on a sandy barrier island - ScienceDirect

also cause groundwater levels to rise more rapidly. It has been shown that in coastal communities that have large increases in summer population associated with tourism, water use, and wastewater discharges (and associated groundwater recharge) may be elevated in the summer months. For example, in Bogue Banks, it was estimated that groundwater recharge associated with wastewater inputs could increase the natural groundwater recharge by approximately 20% annually (O'Driscoll et al. 2019).

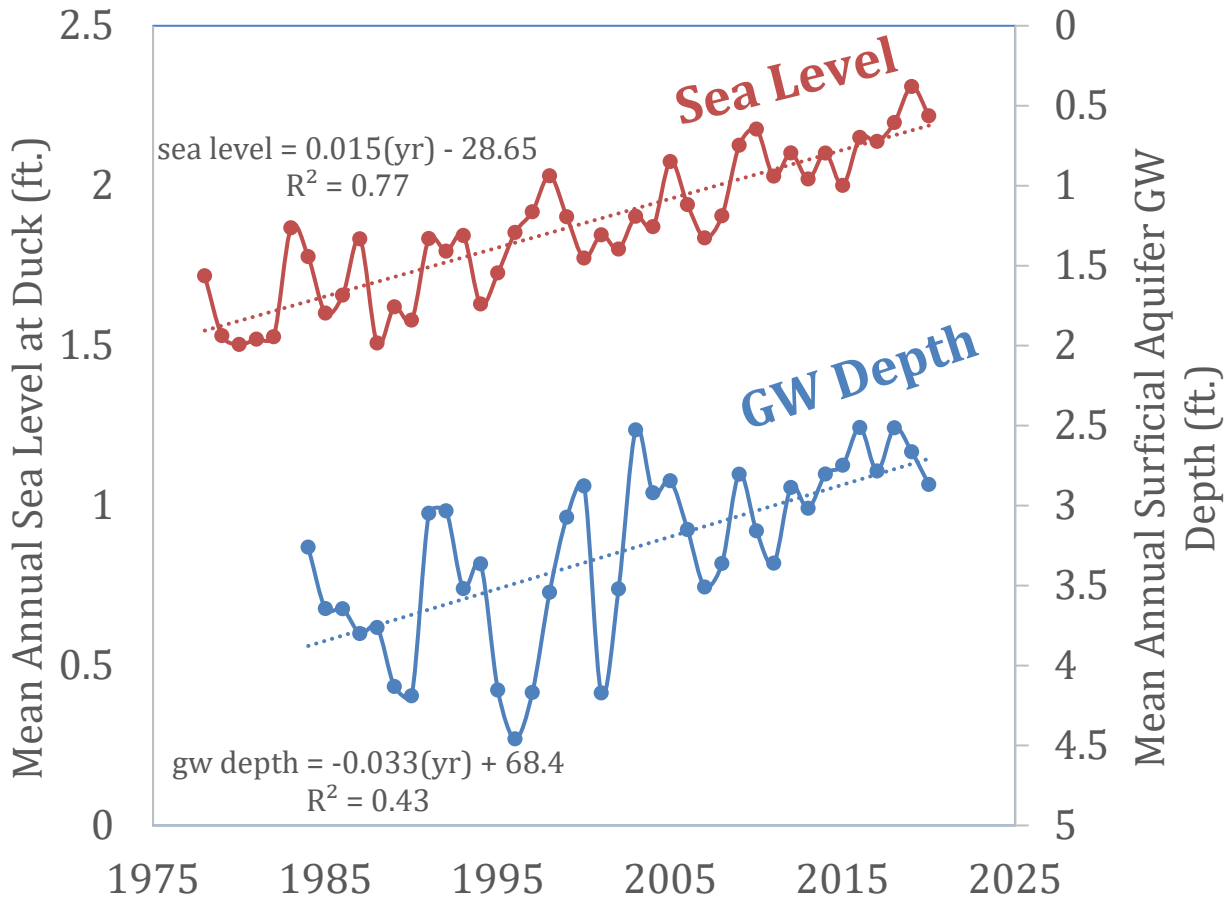


Figure 8-5. Comparison of sea level rise at the NOAA Duck, NC tidal gauge and average annual groundwater depth in NC DEQ surficial aquifer wells (8 sites) in Dare County, NC

Data sources: NOAA and NC DEQ.

The groundwater depths at the NC DEQ and ECU groundwater monitoring sites located in and around Nags Head were compared for a period from 2019-2021 (Figure 8-6). These data and longer-term data suggest that groundwater levels are typically elevated during the winter months when evapotranspiration is minimal. In addition, groundwater levels can be elevated during wetter periods and in some areas may take weeks to months to recede. The South Nags Head (SNH), Wright Memorial (WM), and Bodie Island (BI) sites had shallow groundwater, typically < 3.5 feet deep, suggesting that the vertical separation distance requirements would not be met for conventional septic systems in these areas. The Nags Head Municipal Building (MB) and Dowdy Park (DP) sites would typically have sufficient VSD, however, during wet periods the VSD may be less than 1.5 feet at the Coastal Studies Institute (CSI) and Bonnett St. Beach Access (BS) sites which had deeper groundwater tables and always had sufficient VSD for the period of record. Overall, these data suggested that areas in South Nags Head and near the Wright

Brothers Memorial can have groundwater depths <3.5 feet, indicating that drain fields of conventional septic systems may be inundated by groundwater in these areas, and presumably would have minimal wastewater treatment. At the other sites that were monitored, the groundwater depths were typically greater than 3.5 feet deep, suggesting that during dry periods they would have sufficient VSD to treat wastewater via conventional septic systems. However, at the Nags Head Municipal Building and Dowdy Park, there were brief periods when the groundwater table was elevated and within 3.5 feet of the surface which would indicate that during these high-water table periods, treatment by unsaturated soils could be reduced.

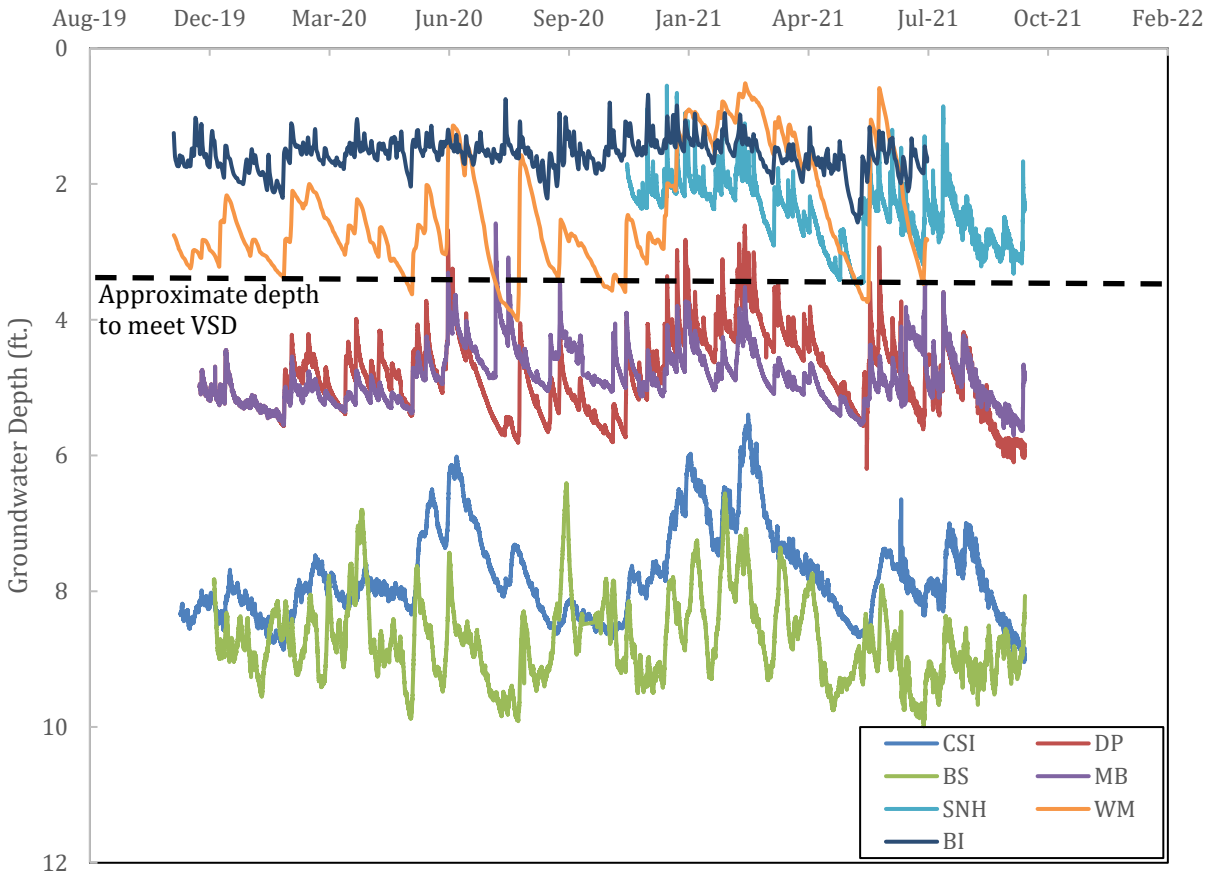


Figure 8-6. Groundwater depths measured at various Nags Head and adjacent locations by ECU and NC DEQ

For reference, the dashed line shows the depth to 1.5 feet vertical separation distance (assuming the drain field trenches are at 2 feet depth; 3.5 feet groundwater depth).

Of the long-term NC DEQ wells screened in the surficial aquifer, one was located in Nags Head at the Bodie Island site. The groundwater depth data trends over time at this well suggest that groundwater levels have been rising since the 1980s (Figure 8-7). The frequency of data collection increased in 2008 and daily groundwater depth and level data have been available since then. These data show that since 2008 there have been at least 3 events where the groundwater levels were above the land surface, suggesting that septic systems in this area and the land surface would have been temporarily inundated. The deepest groundwater depth over the period of record was 3.15 feet, suggesting that conventional systems in this area that are not mounded would likely not meet the vertical separation distance

requirements. When comparing the mean annual daily groundwater depths at the Bodie Island well, the data suggests that groundwater levels are rising with sea level (Figure 8-8). In 2008, the mean annual groundwater depth for the surficial aquifer well at Bodie Island was 1.83 feet and in 2020 it was 1.54 feet deep, suggesting that the mean annual groundwater levels in this area have risen approximately 3.5 inches since 2008.

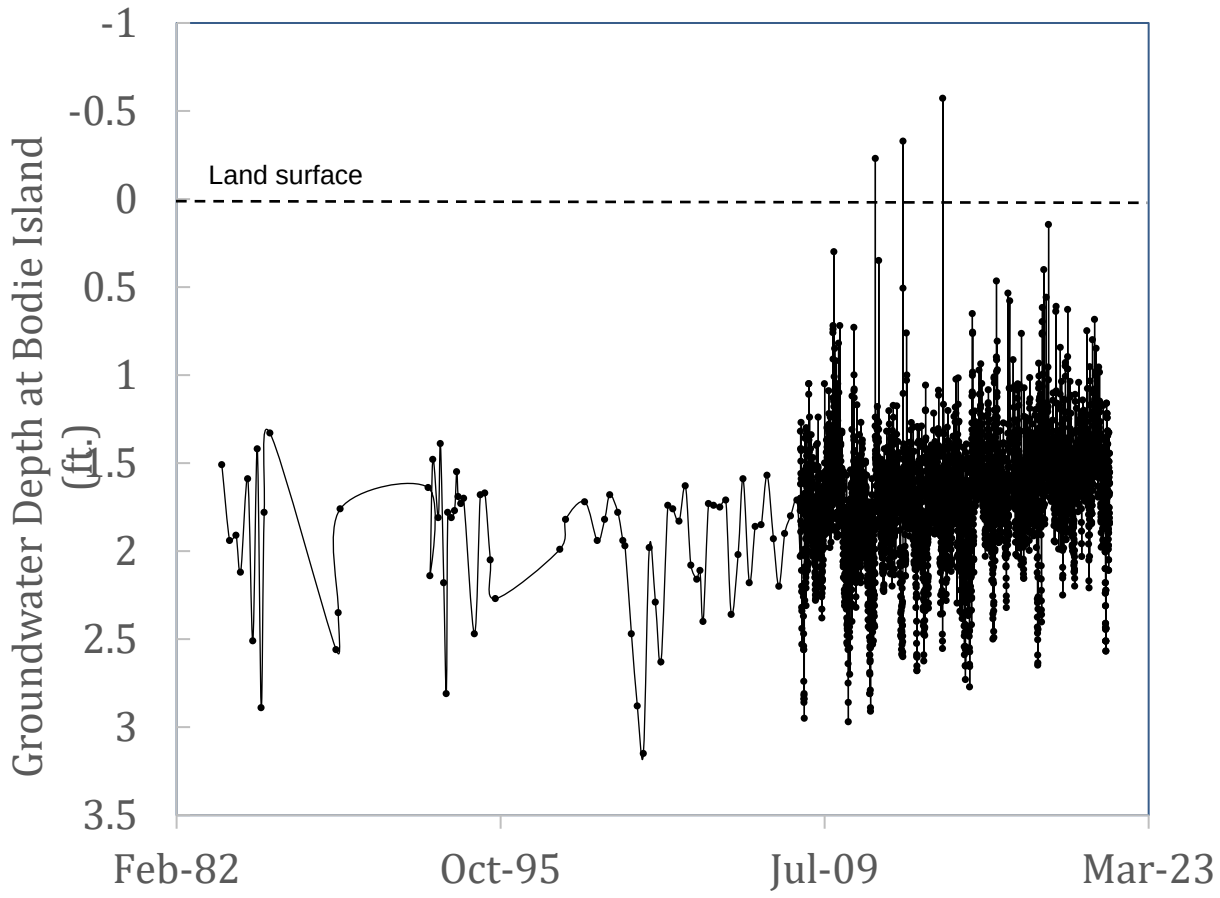


Figure 8-7. Groundwater depths measured in the surficial aquifer at Bodie Island (BI) sites by NC DEQ since 1984

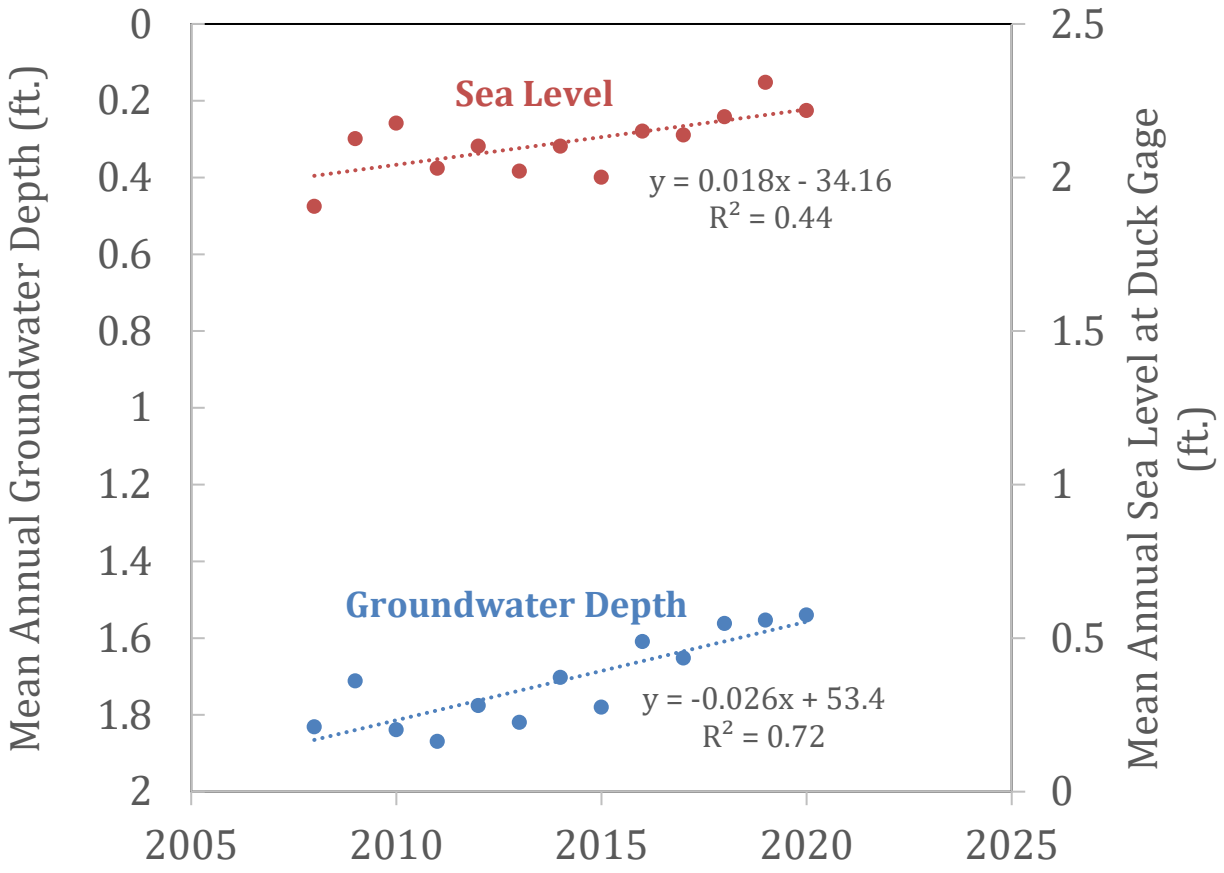


Figure 8-8. Relationship between the mean annual groundwater depths measured in the surficial aquifer at Bodie Island and the mean annual sea level at the Duck tidal gauge

Data from the Bodie Island aquifer has been collected by NC DEQ on a daily basis since 2008. Data sources: NC DEQ and NOAA.

The south Nags Head residential well located to the north of the DEQ Bodie Island well also showed shallow groundwater table conditions (Figure 8-9). At this site the well was located in the drain field, so a direct comparison could be made with the drain field trench depth and groundwater levels. Based on the current record from November 2020 through October 2021, the groundwater was in the drain field trench for approximately 67% of the time. At this site, groundwater depth would need to be 4.1 feet deep to meet the vertical separation distance requirements for sandy soils (1.5 feet). During the 11 months of data collection the groundwater depth was never greater than 0.9 feet below the drain field trench. These data suggest that systems in these shallow water table settings will not typically have adequate soil-based wastewater treatment, particularly in the winter months or during wet periods. For the future, based on recent trends in groundwater level and sea level rise, approximate estimates for the rise in groundwater levels at the Bodie Island well (0.026 feet/year) can be used to evaluate future scenarios for the South Nags Head area. An example is provided for the South Nags Head residential site (Figure 8-10). The recently monitored groundwater depths were compared to an approximation for what the groundwater levels would have been like in 1988 when the system was installed. At that time the groundwater levels would have likely been below the drain field trench for most of the year, except during and shortly after large rain events. Projecting forward to 2050, the data suggest that the drain field trench would likely be

inundated year-round and during wet periods the groundwater may rise to the surface at this site and other sites at similar elevation (land surface at approximately 4 feet above sea level).

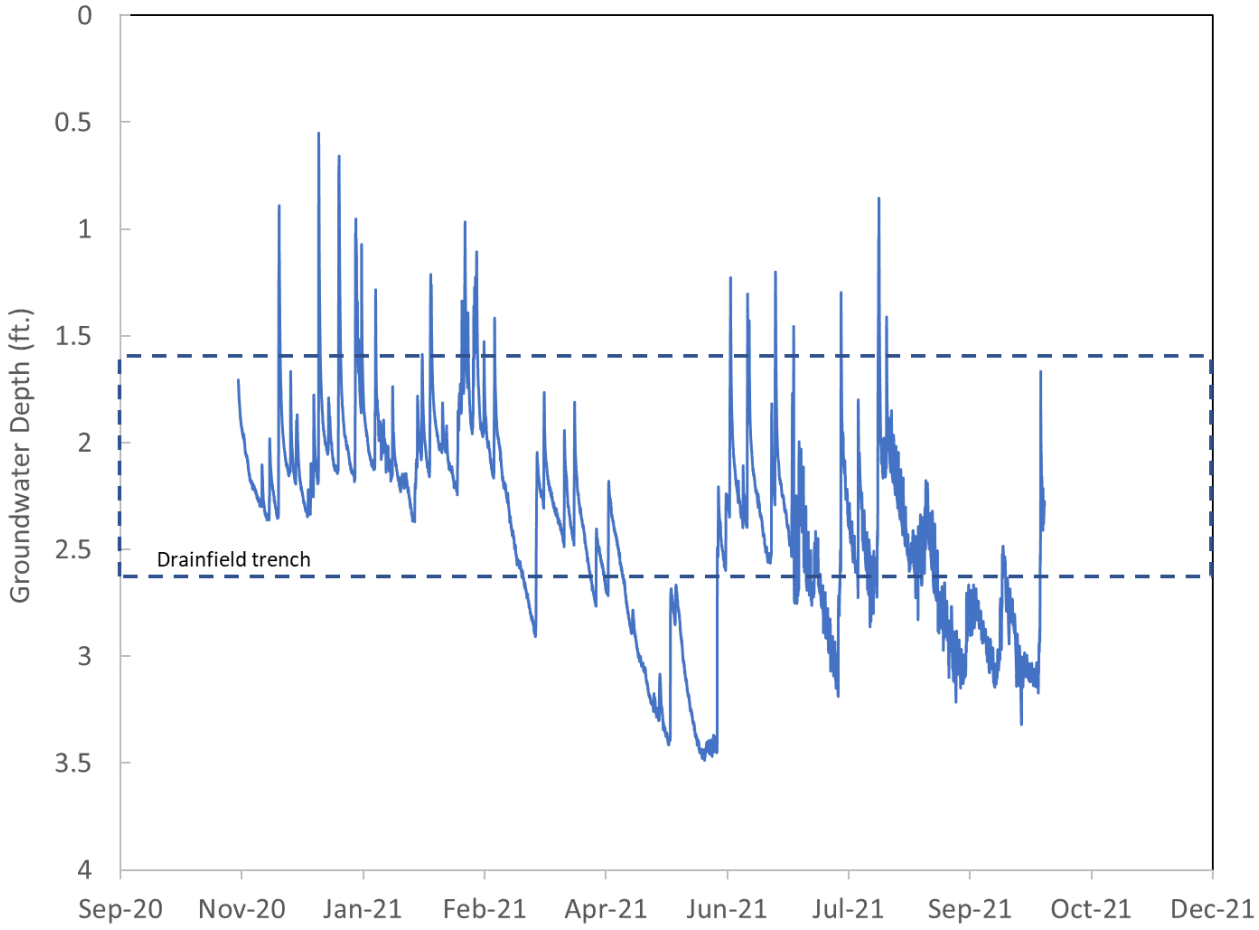


Figure 8-9. Groundwater depths measured every half hour from Nov. 2020-Oct. 2021 in the drain field at the South Nags Head residential site

The approximate depth of the drain field trench (1.6-2.6 feet deep is included). During the monitoring period groundwater inundated the drain field for approximately 67% of the time and was never below 3.2 feet deep. For adequate vertical separation distance based on the NC rules for sandy soils, groundwater depths of greater than 4.1 feet deep would be needed at this site.

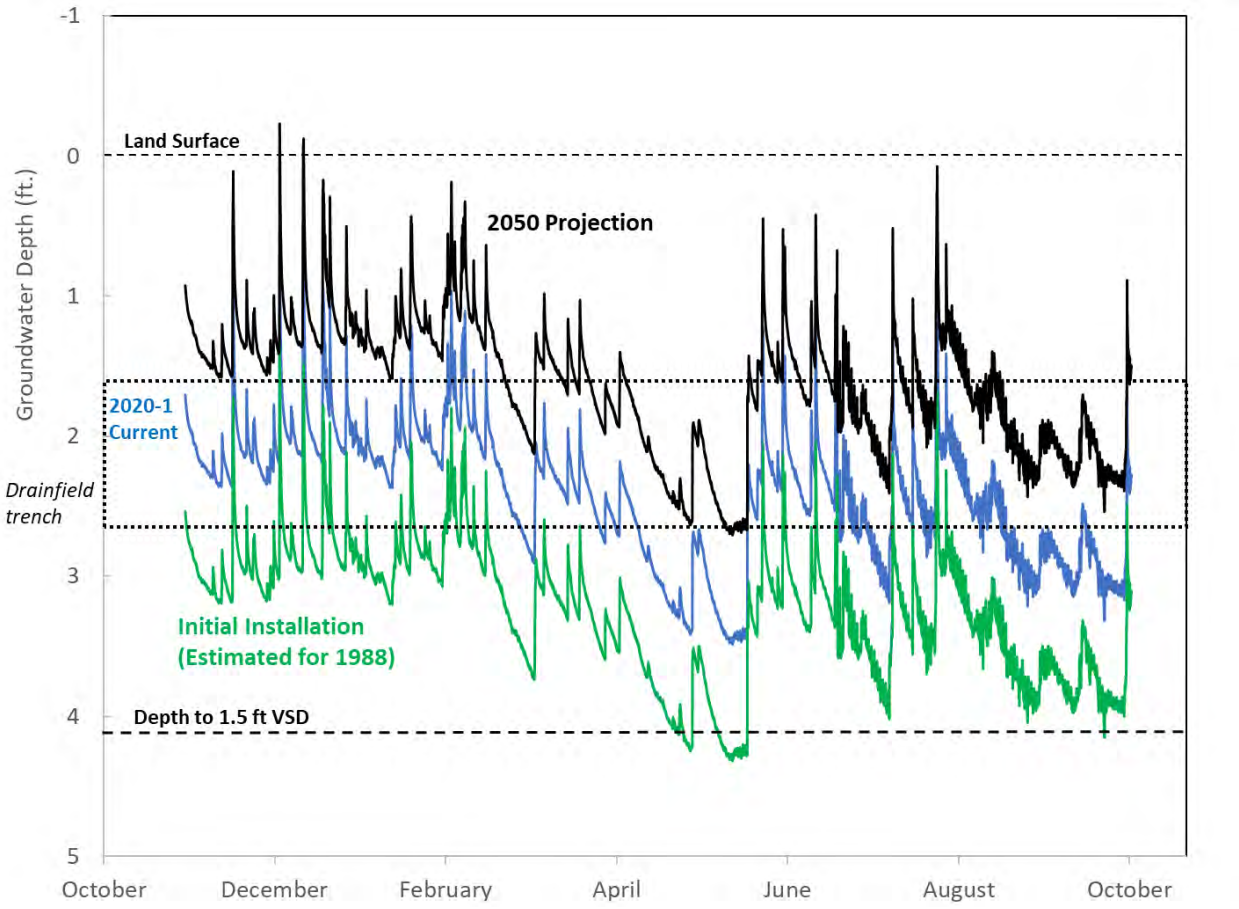


Figure 8-10. Comparison of initial (1988), current (2020), and projected (2050) groundwater levels at the South Nags Head residential site

The blue line shows groundwater depths at the South Nags Head residential site for the current monitoring period (Nov. 2020-Oct. 2021). The green line shows an approximation for what the groundwater levels would have been like in 1988 when the system was installed (based on the recent groundwater level rise trend of 0.026 feet/year. measured at Bodie Island). The black line shows what the groundwater levels may be like in 2050 based on the recent rates of groundwater level rise in the area.

8.2 Subsurface Water Quality Beneath Septic Systems

Wells for groundwater monitoring were installed between the trenches of the septic system drain fields serving Dowdy Park (DP), the Town of Nags Head municipal building (MB), the Bonnet Street beach access (BS), and a private residence in South Nags Head (SNHR) (Figure 8-11). Wastewater samples from the septic tanks and groundwater samples from the monitoring wells were collected 9 times between January 2020 and December 2021 for nitrogen, phosphorus, and *E. coli* analyses. Laboratory work was conducted at East Carolina University. Physicochemical properties of groundwater and wastewater including pH, oxidation reduction potential, temperature, and specific conductance were measured in the field using various multiparameter meters. Also, during each sampling event the depth to groundwater and vertical separation distance between the drain field trenches and groundwater were determined.

Figure 8-11. Groundwater well installation photos

Groundwater wells were installed near the drain fields of the septic systems at the Town of Nags Head Municipal Building (top), Dowdy Park (middle), and the Bonnet Street beach access (bottom). Groundwater samples from the wells and wastewater samples from the septic tanks were collected for nutrient and bacteria concentration analyses and to determine the treatment efficiencies of the systems. A residential septic system site in South Nags Head was also instrumented.

8.2.1 Nitrogen Treatment

The median concentrations of total dissolved nitrogen (TDN) in groundwater below the drain fields of the septic systems were between 68% and 96.8% lower relative to wastewater concentrations for the septic systems at Dowdy Park (DP), Bonnet St. (BS), and the municipal building (MB) (Figure 8-12). Nitrogen concentrations in wastewater and groundwater were variable over the study. The drain field trenches for each of these systems had a mean separation distance to groundwater that exceeded 2 ft (Table 8-1) thus enabling oxidation of wastewater as it infiltrated the soil. Total Kjeldahl Nitrogen (TKN) which includes NH_4 and organic nitrogen, comprised on average 98.7% or more of the total nitrogen concentration in wastewater sampled from the septic tanks at each of the sites (Table 8-1). Nitrogen in groundwater near the drain fields at DP, BS, MB was mostly (> 82%) NO_3, indicating that the nitrification process (conversion of NH_4 to NO_3) was occurring in the > 2 ft vadose zone at those sites. However, the septic system serving the residence at South Nags Head (SNHR) experienced groundwater inundation of the trenches or within 0.1 ft during each sampling event. Therefore, septic tank effluent was discharged directly to groundwater (0% treatment efficiency). Evidence of wastewater oxidation in soil beneath the drain field at SNHR was not observed as the % of total nitrogen that was TKN in wastewater (99.7%) and groundwater near the system (99.8%) were nearly identical (Table 8-1). Nitrification in the vadose zone beneath septic drain fields often results in a lowering of the pH of groundwater because H^+ is released when NH_4^+ is converted to NO_3^-. The average pH of groundwater at DP, BS, MB were all at least 0.5 pH units lower relative to wastewater at those sites, but at SNHR the mean pH of groundwater was 0.2 units higher relative to wastewater (Table 6). Also, groundwater near the drain field at SNHR had the lowest average oxidation reduction potential (ORP) (-37 mV) and the smallest difference in ORP between wastewater and groundwater (-106 mV). The other sites had higher mean values of ORP (6 to 49 mV) and larger differences in ORP values compared to wastewater at those sites (156 to 234 mV) (Table 8-1). These data suggest that wastewater treatment of nitrogen at SNHR site was limited due to the small vertical separation distance that prevented nitrification, an important step in removing nitrogen via denitrification (Lusk et al. 2017).

8.2.2 Phosphorus Treatment

The median concentrations of phosphate (PO_4-P) in groundwater below the drain fields of the septic systems were between 82.4% and > 99% lower relative to concentrations in wastewater sampled from DP, BS, and MB (Figure 8-13). These septic systems were very efficient at reducing PO_4-P concentrations. Processes including adsorption and/or mineral precipitation were active at these sites. Given the mean pH and redox potential of groundwater near the septic systems, it is possible that the mineral Vivianite (Fe3(PO4)2·8H2O) could have precipitated if sufficient iron was available in soil water beneath the trenches. However, the residential septic system in South Nags Head was discharging wastewater with a median PO_4-P concentration of 8.45 mg L^{-1} directly to groundwater during the sampling events. Prior studies have shown that most phosphorus attenuation occurs in the vadose zone prior to infiltrating wastewater reaching groundwater (Lusk et al. 2017). Because there was no vadose zone during the sampling events at SNHR, adsorption and precipitation reactions were not likely.

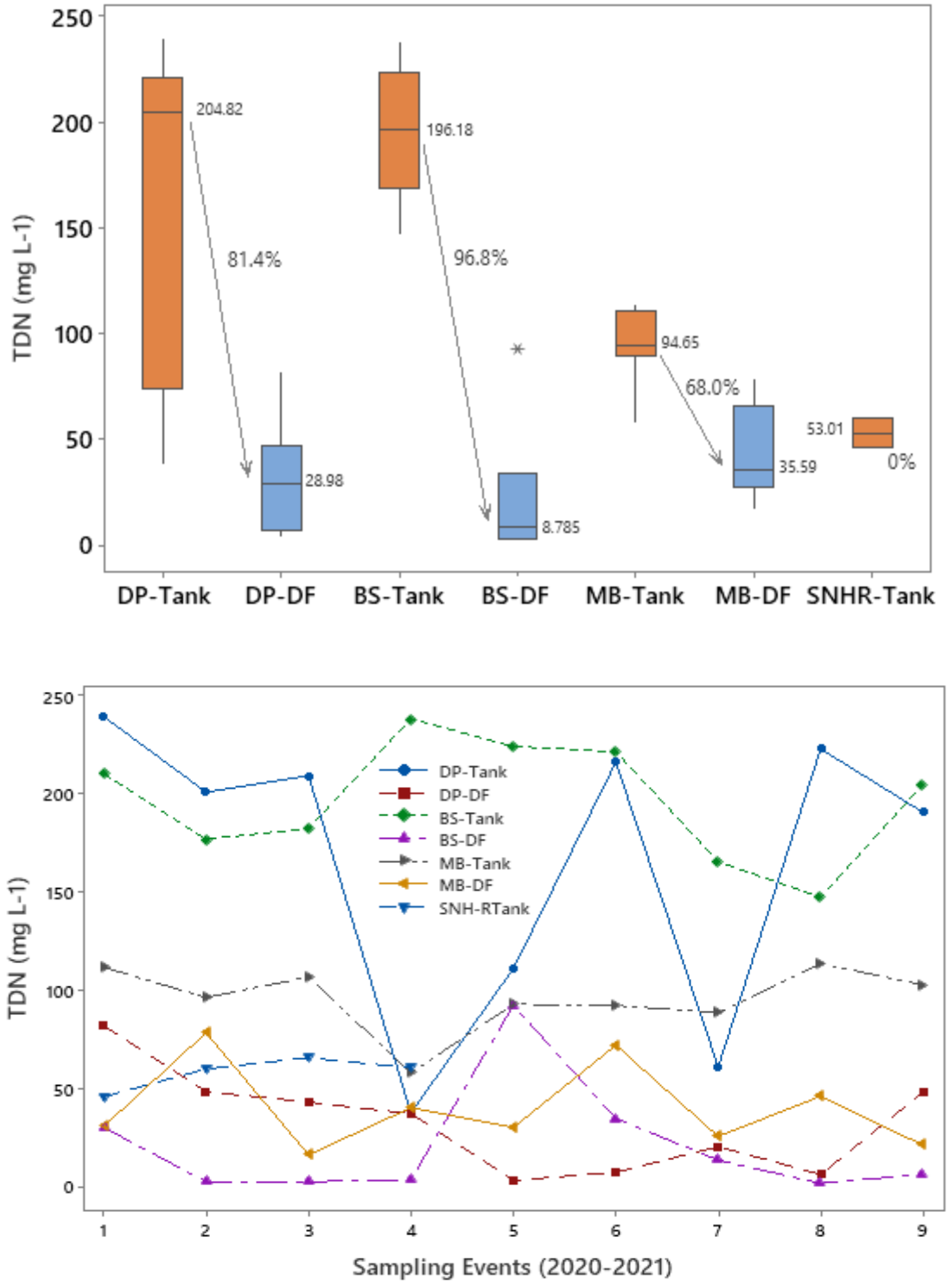


Figure 8-12. Boxplots (top) and time series plots (bottom) showing nitrogen concentrations in wastewater (tank) and groundwater (DF) near the septic systems

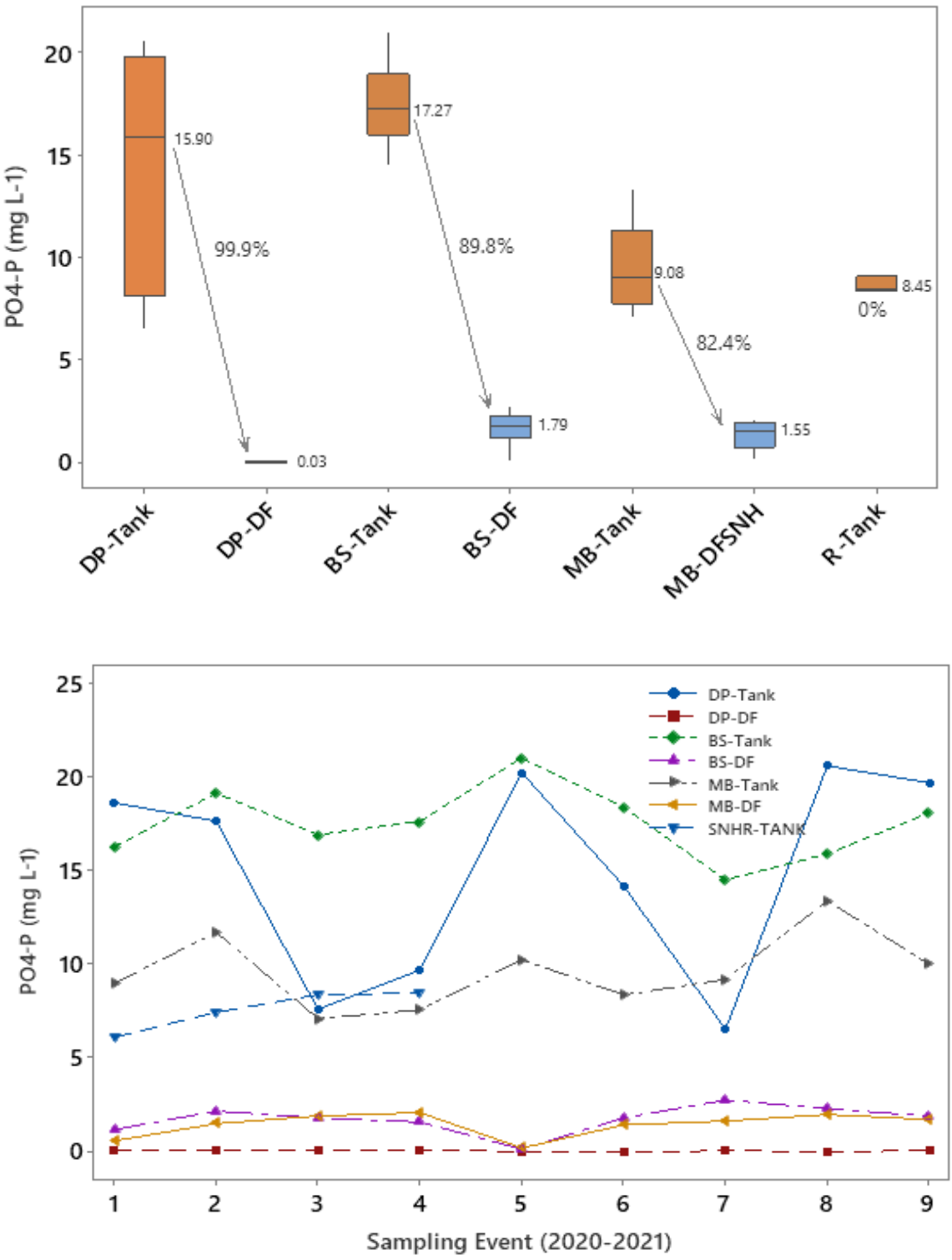


Figure 8-13. Boxplots (top) and time series plots (bottom) showing phosphate concentrations in wastewater and groundwater near the septic systems

Table 8-1. Average of the physical and chemical properties of wastewater and groundwater near the drain fields of the septic systems at research sites in Nags Head, NC

Location	Depth to Water (ft)	Vertical Separation (ft)	%TKN	%NO3	pH	SC (uS/cm)	ORP (mV)
DP-Tank			98.7	1.3	8.1	2739	-194
DP-DF	4.7 (3.3 - 5.4)	2.4 (1.1 - 3.2)	17.3	82.7	6.2	717	49
BS-Tank			99.8	0.2	7.9	2834	-151
BS-DF	8.19 (6.2 - 9.2)	5.69 (3.7 - 6.7)	7.9	92.1	6.9	751	6
MB-Tank			99.8	0.2	7.6	1600	-181
MB-DF	4.72 (3.9 - 5.3)	2.92 (2.1 - 3.5)	3.2	96.8	7.1	978	41
SNGR-Tank			99.7	0.3	6.8	1053	-143
SNHR-DF	2.43 (2.0 - 2.7)	0 - 0.1	99.8	0.2	7	317	-37

8.2.3 Bacteria Treatment

The median concentrations of *E. coli* in groundwater beneath the septic drain fields at DP, BS, and MB were each less than 3 MPN 100 mL^{-1} (Figure 8-14). There was a 4 to 5 log-based reduction (reduced by a factor of 40 to 50 times) in the concentration of *E. coli* at each of these sites indicating these systems were very effective at lowering concentrations of *E. coli*. The thick (> 2 ft) vadose zone at these sites likely enabled filtration, die off, and adsorption of the fecal indicator bacteria. The highest concentration of *E. coli* in groundwater reported for the BS (70 MPN 100 mL^{-1}), DP (36 MPN 100 mL^{-1}), and MB (16 MPN 100 mL^{-1}) sites were still at least 3 orders of magnitude lower than wastewater sampled during those events. The SNHR site was discharging wastewater with a median *E. coli* concentration of 185,000 MPN 100 mL^{-1} directly to groundwater. Thus, at this site there was no opportunity for filtration or adsorption of *E. coli* in the soil beneath the system due to insufficient vertical separation.

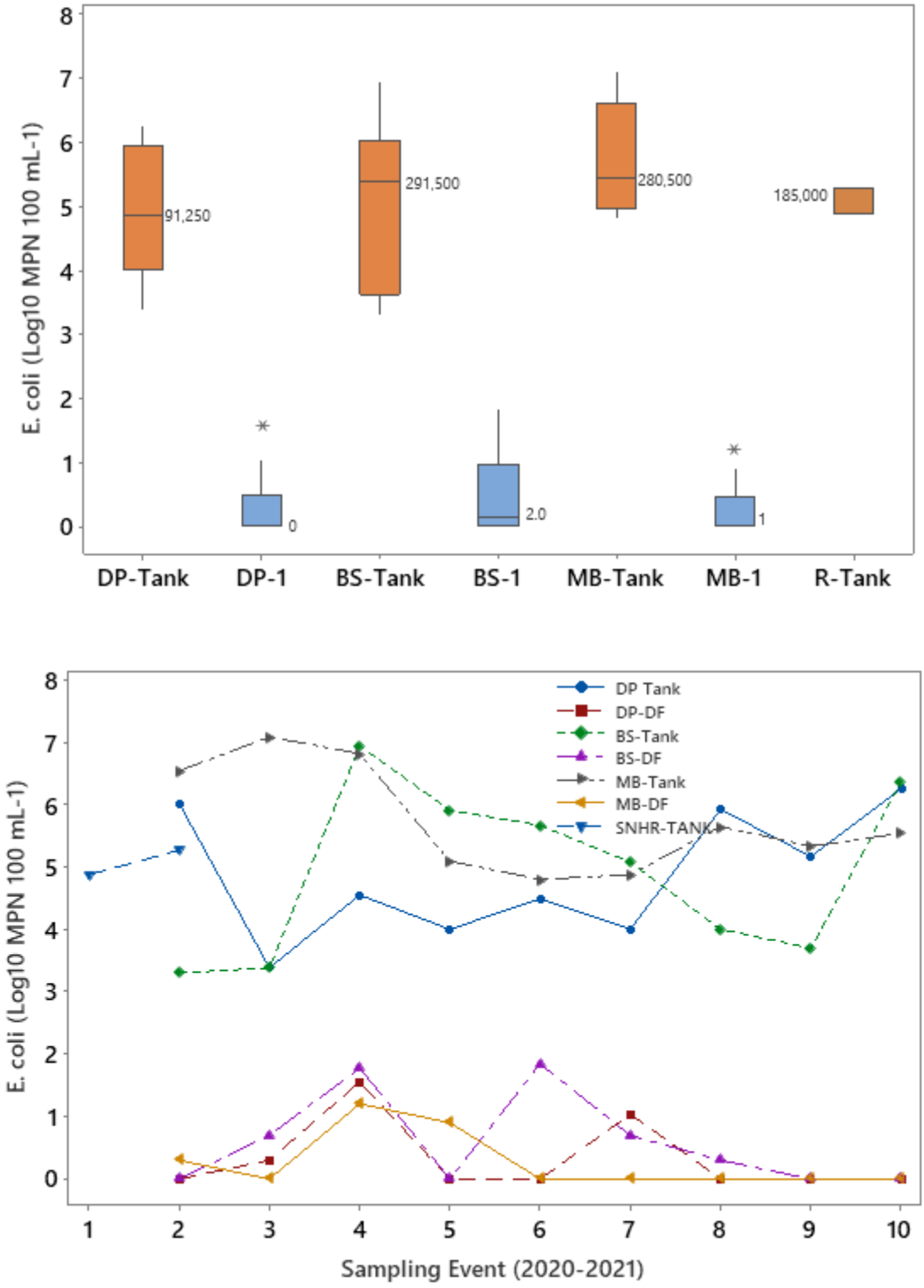


Figure 8-14. Boxplots (top) and time series plots (bottom) showing *E. coli* concentrations in wastewater and groundwater near the septic systems

8.3 Recommendations and Action Items

The groundwater monitoring conducted by ECU CSI obtained 11-months of sampling data set that provided an accurate, but narrow window as to what is happening with groundwater, subsurface water quality, and septic. In general, more data and monitoring is needed to gain a complete and more substantial understanding of what is going on. While this data set provided four (4) groundwater elevations in Nags Head, additional continuous remote groundwater elevation monitoring should be conducted in Nags Head to determine seasonal variations, long-term variability, and effects of groundwater lowering projects.

The installation of ten (10) additional remote groundwater sensors is recommended to continuously log data and determine average groundwater levels and compare to established limits. These locations were selected to provide a better spread of data (gap location) in locations known to have high groundwater tables less than 36-inches from the surface.

Installation of continuous groundwater level data loggers in low lying areas across Nags Head would allow staff to gain a greater understanding of groundwater levels across Nags Head and potential impacts to septic systems and drain fields.

Below is a list of recommendations to enhance the groundwater elevation data:

1. Purchase ten (10) remote groundwater data loggers and place in new locations above. The estimated cost is $2,185 per logger.
2. Add ten (10) groundwater monitoring wells in areas with high groundwater tables at locations less than 7-feet MSL to better understand groundwater table rise in the town. Based on the gaps in data, the following locations are recommended:
    1) Huron Street
    2) Hargrove Street at the Beach Access
    3) Jennette's Pier
    4) South Nags Head Water Tower
    5) East Seagull Drive
    6) Jockey's Ridge East
    7) United States Postal Service Office – Corner or Deering Street and US 158
    8) W. Soundside Road
    9) Kitty Hawk Kites
    10) East Admiral Street

    Below is a map of additional groundwater well monitoring locations in addition to the ECU CSI groundwater monitoring well locations.
3. Data could be shared via the town website using an online GIS map with green, yellow, red levels. Graphs or charts and pictures can also be added.

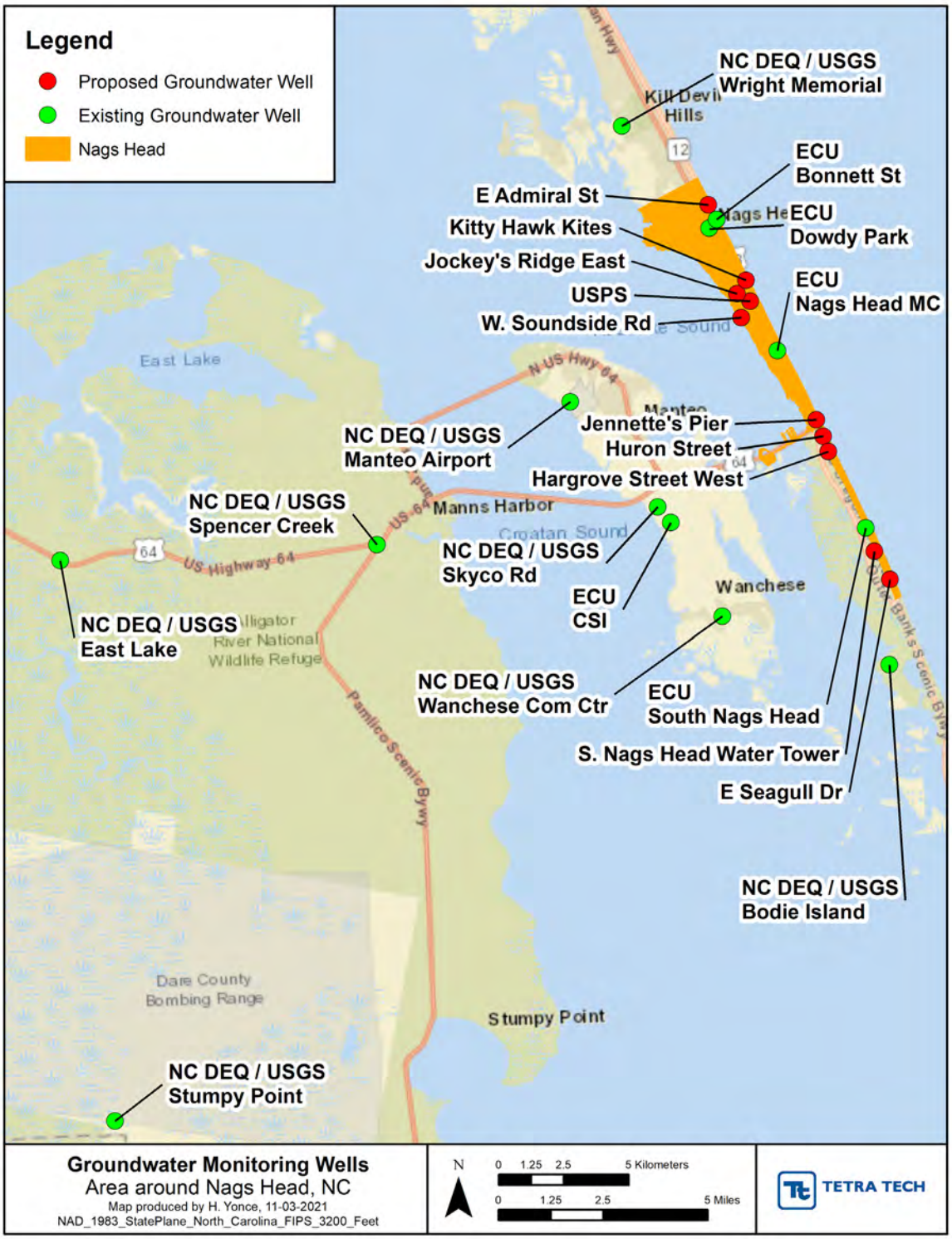


Figure 8-15. Additional Groundwater Well Locations for Continuous Elevation Monitoring Shown in Red.

SECTION 9.0

Future Conditions

9.0 Future Conditions

As conditions change in Nags Head so does the town's vulnerability. Future conditions include changes often associated with climate change such as increased precipitation, sea level rise, flooding, storm surge, erosion, and impacts to groundwater table elevations. These future changes can be examined independently and in conjunction with one another as one future condition can actually impact or exacerbate another. This is most evident in Nags Head with the observation of increases in more frequent, high intensity rainfall events combined with high groundwater tables that result in localized flooding.

The Outer Banks Regional Hazard Mitigation Plan, adopted in 2020, and the NC Climate Science Report, revised in September 2020, both discuss how future conditions may affect the Town and region. These changing future conditions will need to be taken into consideration for the continued use of septic system treatment viability. Section 10 outlines septic system planning guidance for utilization of more advanced systems based on current onsite conditions, which may also be utilized for future conditions as the climate changes.

9.1 Sea Level Rise

There are two scales on which sea level change is discussed: global sea level and relative (local) sea level. Globally, ocean heat (thermal expansion with warmer water and contraction with cooler water) and the melting of land-based ice are the main contributors to sea level. However, of greater concern to Nags Head is relative sea level change, or the difference in elevation between the surface of the ocean and the local land, averaged over time to eliminate the influence of tide and season. This relative sea level change is also influenced by vertical land motion and ocean dynamics in the region. Predicted impacts of sea level rise on the Outer Banks vary in both time and space. Coastal and inland low-lying areas will be subject to more frequent flooding due to coastal, surface water, and groundwater flooding types.

Multiple studies from a wide variety of agencies including the NC Department of Environmental Quality Division of Coastal Management's 2020 Climate Science Report outlines moderate (1.3 to 2.4 feet) and high (2.0 to 3.6 feet) increases in SLR scenarios for North Carolina. The North Carolina Climate Science Report (Kunkel et al. 2020) recently provided an overview of sea level rise along the North Carolina Coast. The analysis provided for conditions at Duck and Oregon Inlet, North Carolina which can be used to provide insights for potential future conditions and trends that can affect Nags Head and other similar communities in the northeastern coastal region of North Carolina. The relative sea level data revealed that sea level at Duck has been rising at a rate of 1.82 inches/decade (1978-2018) and at Oregon Inlet at a rate of 1.85 inches/decade (1977-2018). The report projected that the increases in sea level will result in a greater frequency of high tide flooding in the future. Additionally, these changes will exacerbate flood conditions during and after extreme precipitation events. For the Duck, NC area future projections were estimated based on intermediate-low to intermediate global sea level rise scenarios, (approximate projections under models that use the representative concentration pathways (RCP) 4.5 (low-intermediate) and RCP 8.5 (intermediate). The RCPs provide scenarios that vary based on future greenhouse gas concentrations. The future sea level projections provided for Duck, NC show a range of likely scenarios, with estimates of sea level rise by 2100 ranging between approximately 0.7 to 1.3 meters or 2.1 to 4.3 feet. Based on these scenarios, average likely change of sea level would be approximately 1.0 meter or 3.2 feet sea level rise by 2100. The Climate Science Report outlined a higher scenario with high tide flooding of 1.6 to 2.1 feet above mean higher high water (the average of each day's higher high

tide line) which is projected to become a daily occurrence under both the low and high scenarios by the year 2100.[25]

While sea level rise is often thought of as a rise in the ocean height, it has many more impacts on the land than simple inundation (flooding). Sea level is a component of the rates of erosion and can also interact with coastal aquifers, influencing both water table height and salinity. These types of impacts can affect Nags Head long before dry land is permanently flooded. Sea level rise also adds to storm surge on both ocean and sound sides, not only changing the rate of erosion but also increasing the potential hazards from overwash. In addition, it is possible that a change in sea level may alter the potential risk of an inlet opening during exceptionally severe storm surges. Higher water tables, especially coupled with these type events where sea level increases on top of storm surge, could keep ocean outfalls inundated longer and may slow drainage leading to prolonged flooding in low lying areas. Additionally, chronically higher and saltier water tables may impact septic system function. It is not yet known how severe such impairments would need to be to affect surface water quality.

While the data and models are varying and predictability is an estimate, developing a proactive decentralized wastewater management strategy for SLR would benefit future development and repairs/replacement of septic systems. Part of this strategy should include the development and adoption of a range of sea level rise scenarios.

A future management plan for areas affected by higher flooding and SLR may include considerations for advanced treatment, innovative systems, non-point decentralized wastewater cluster systems, or central sewer if no other option exists. Section 10.0 outlines a matrix of options for septic system treatment that can aid the town and Dare County in decision making for septic system installations for new systems, retrofits, repairs, and replacement of existing or failing systems.

9.2 Precipitation

Short-duration high-intensity rainfall events are becoming more prevalent in recent years. Nags Head has experienced expanded wet weather patterns and high-intensity rainfall events, primarily during the summer months, which can result in localized flooding throughout town. The Climate Science Report suggests that annual total precipitation will likely increase for North Carolina. It is also very likely that extreme precipitation frequency and intensity (high intensity, short duration) storms will increase due to increases in atmospheric water vapor content.[26] The Outer Banks Regional Hazard Mitigation Plan also discusses that climate change is expected to make heavy rain events and tropical storms and hurricanes more frequent and intense.[27]

With global warming, stronger more intense hurricanes are ranked medium as outlined by the Climate Report. While heavy precipitation is ranked very likely.[28] Hurricane Matthew in October 2016 is the present-day rainfall event for the Outer Banks which all other storms are measured against with areas receiving as much as 12-inches of rainfall during a four and a half-hour period.

[25] NC Climate Science Report, p. 7.

[26] NC Climate Science Report, p. 6.

[27] Outer Banks Regional Hazard Mitigation Plan, Section 4 – Risk Assessment, Climate Change, p. 75.

[28] NC Climate Science Report, p. 7.

During Hurricane Harvey, southeast Texas received over 56-inches of rain breaking all probable maximum precipitation records. This led to the development of new intensity-duration-frequency (IDF) curves. New curves are being developed under NOAA Atlas 14 using Precipitation Frequency Data information. These new design standards account for higher storms and aid engineers in designing stormwater infrastructure to carry future condition storm events.

9.3 Flooding

The Climate Report ranked flooding as virtually certain due to SLR and increasing intensity of coastal storms due to storm surge. In addition, extreme precipitation will increase inland flooding.

Flooding from a hurricane or nor'easter can cause strong wave action, storm surge, ocean over wash, beach erosion, and soundside erosion. Water can inundate large portions of Nags Head causing widespread flooding. As discussed in Section 9.2 above, in October 2016, Hurricane Matthew produced over 12-inches of rainfall in Nags Head.

High precipitation can also cause flooding which may not be immediate and can inundate areas long after a storm passes.

Flooding in Nags Head often is associated with heavy rainfall or storm surge from hurricanes or nor'easters. However more recently, the Town has been affected by flooding from more frequent, high intensity rainfall event such as observed with Hurricane Matthew in October 2016 and a series of rainfall events in 2017. Property damaged caused by flooding since 1999 has been over $19 million.[27]

Figure 9-19-1. Flooding in Nags Head resulting from Hurricane Matthew (2016)

The Town of Nags Head has been extremely active in addressing flood control in recent years. In 2016, the town embarked upon an update to its Stormwater Master Plan. The initial work was comprised of field location of the existing stormwater infrastructure to be utilized for future drainage infrastructure planning efforts. This effort aided in the development of a town-wide drainage assessment to identify flood-prone areas throughout town. In total, eighteen (18) individual problem areas were identified and synthesized into (13) thirteen potential Capital Improvement projects. Of the thirteen projects identified, five have been constructed, one project is in the process of being designed, two have been designed and yet to be funded, two planned for maintenance, and one to be submitted for grant funding. Project solutions incorporate groundwater lowering techniques to maximize their effectiveness. This results in a holistic

approach to address the concerns associated with flood control and water quality in addition to the secondary benefit of impacts on on-site wastewater system performance.

Flooding can inundate septic systems that lead to a saturated drain field that is unable to drain and treat wastewater, potentially causing it to fail. It is beneficial to have a septic system inspected after a flooding event over the system to ensure it is functioning properly and to look for any signs of damage. US EPA suggests having the septic tank pumped after water has receded to remove any debris or silt that may have washed into the system. Additional education related to septic system maintenance after a flood would be beneficial to include in the SHI. This was identified in the Outer Banks Regional Hazard Mitigation Plan under action # NGH2.[29]

[29] Outer Banks Regional Hazard Mitigation Plan, table 4.2, p. 298

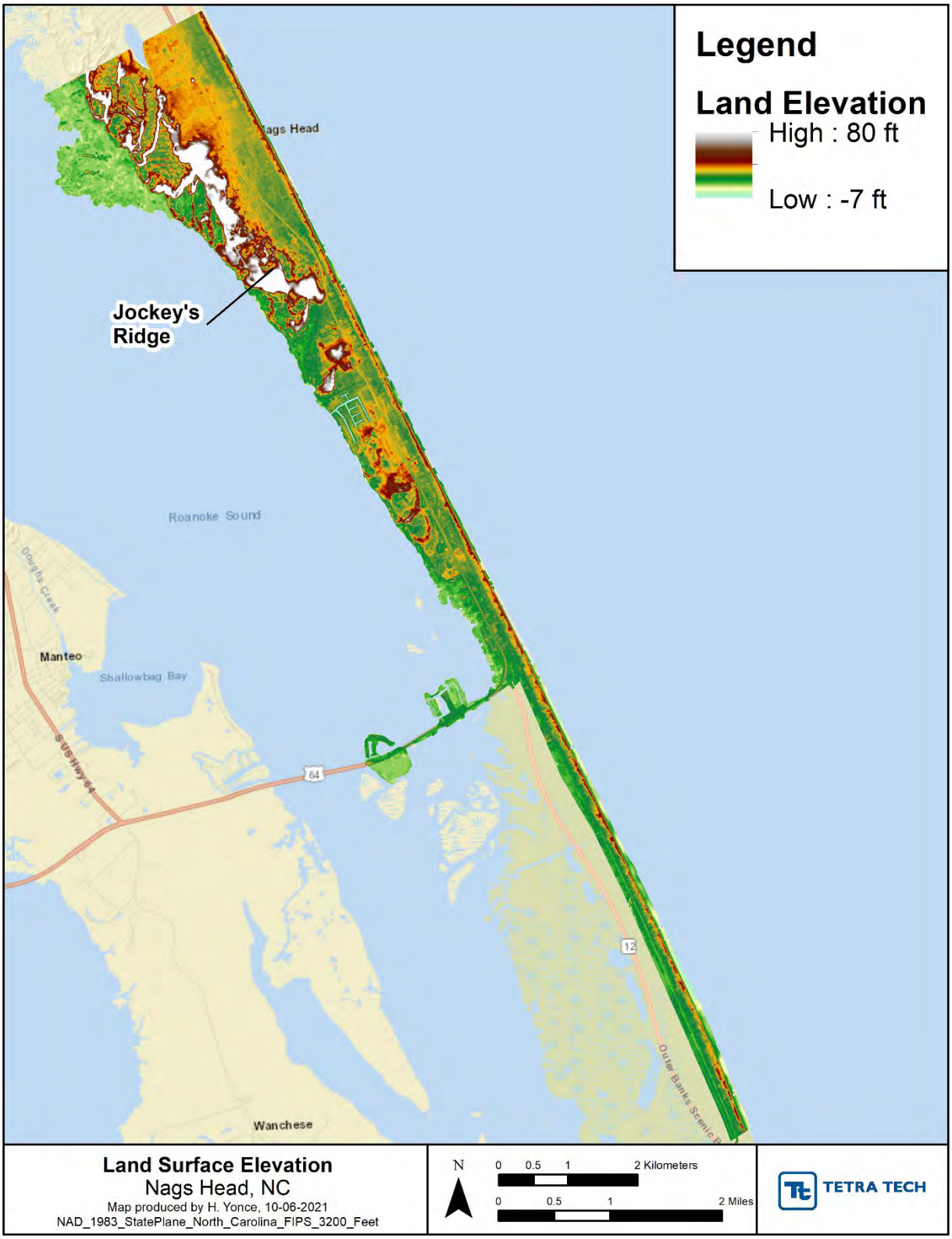


Figure 9-2. Land surface elevation

9.4 Groundwater Table Elevation Rise

Groundwater levels in Nags Head vary based on the seasonal dynamics of precipitation inputs, evapotranspiration, and ocean and estuary water levels. An analysis of groundwater table elevation data collected and gathered as part of the project, “Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas” is described in Section 8.0. This partnership allowed the town to better understand how rising groundwater tables impact septic system functionality.

Based on the approximate relationship of mean annual groundwater depth and land surface elevation, the assumption is that onsite system drain fields are typically buried approximately two feet deep. The NC vertical separation distance (VSD) requirement of 1.5 feet for sandy soils is estimated that conventional systems for residential sites are likely experiencing some groundwater inundation into the drain field at sites that have land surface elevations that are less than six to seven feet elevation above mean sea level. Assuming that groundwater level rises at similar rates as sea level, by 2100 sites that are at land surface elevations of less than nine to ten feet would likely experience groundwater inundation in drain fields as well.

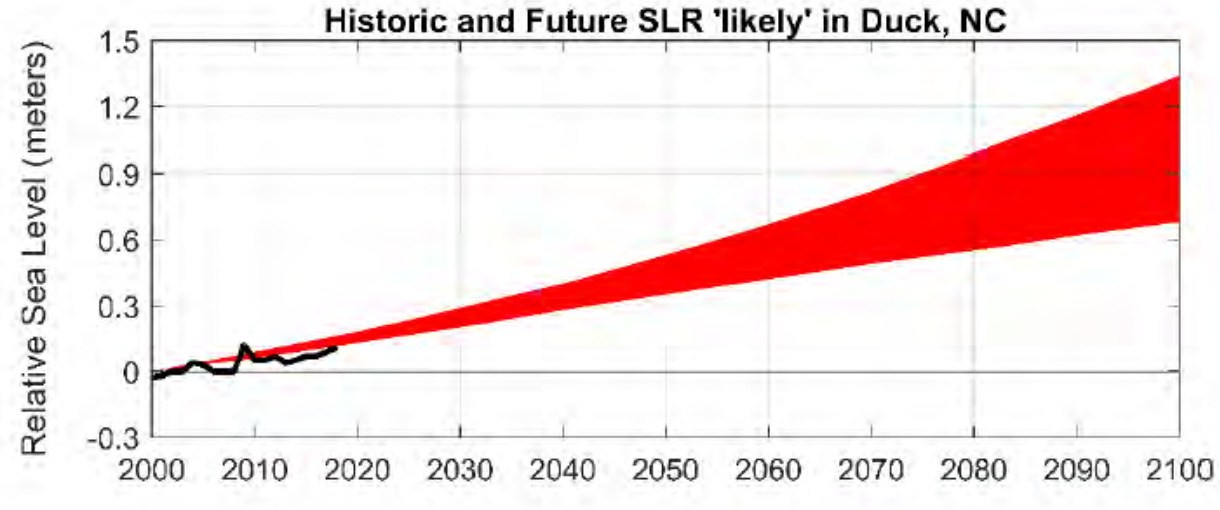


Figure 9-3. Observed relative sea level at Duck, NC for 2000-2018 (black line) and projected relative sea level rise (red shaded area) through 2100

The information in Figure 9-3 is based on intermediate-low to intermediate global average sea level rise scenarios. Figure modified from the North Carolina Climate Science Report (Kunkel et al. 2020).

The town has installed several groundwater lowering wells and associated pumps near west of Highway 158 to combat the rising groundwater tables. Future groundwater lowering wells may be needed in other areas as conditions change to combat SLR and groundwater table elevation increases.

Figure 9-5. Locations of groundwater lowering projects across Nags Head

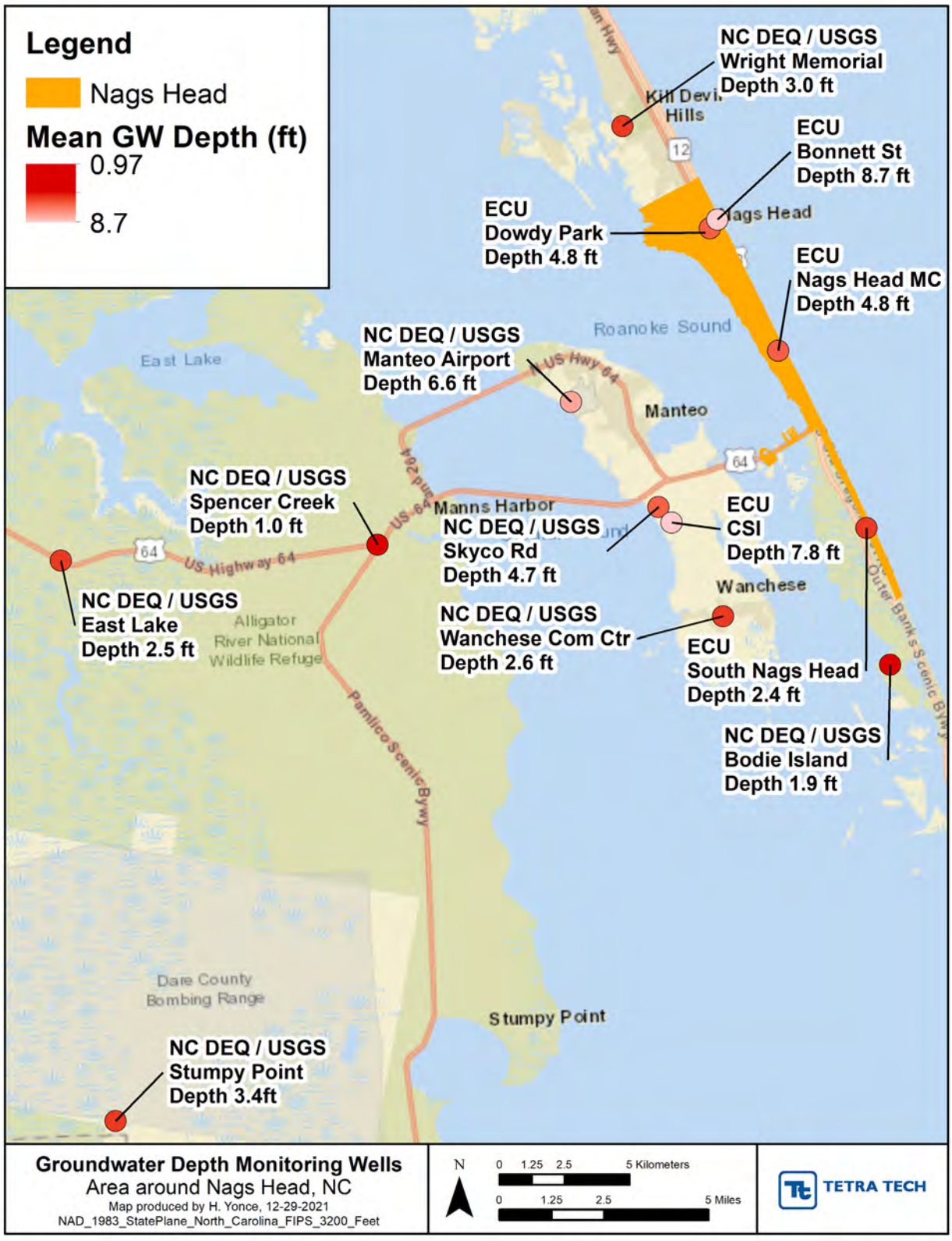


Figure 9-6. Groundwater monitoring wells and mean depths around Nags Head (USGS/DEQ, ECU)

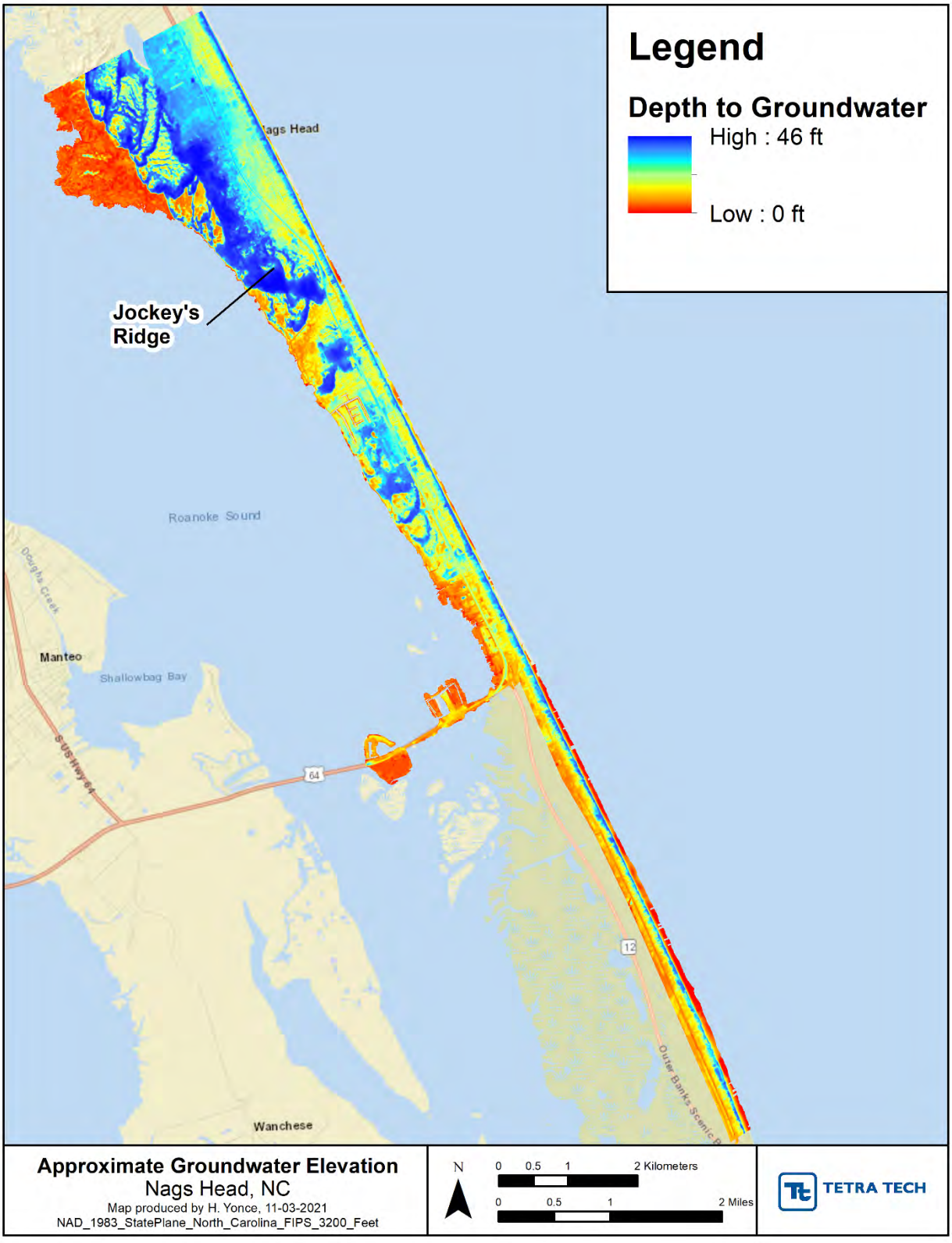


Figure 9-7. Approximate average depth to groundwater across Nags Head

9.5 Community Resiliency

The Town of Nags Head led an effort from 2015-2017 that resulted in a report entitled, “Adaptation Planning in the Town of Nags Head: Vulnerability, Consequences, Adaptation, Planning Scenarios (VCAPS) Report.” This project examined the systems that may be impacted by environmental resiliency and developed a set of priority actions for implementation that would support the identified resiliency goals. “The VCAPS process was intended to help the Town of Nags Head become more hazard resilient and included a strong stakeholder input process. During VCAPS project, the community members:

- Engaged in dialogue about future hazards
- Integrated local knowledge and experience about how the community will be impacted
- Identified gaps in data, knowledge or understanding
- Thought strategically about how to prevent harm by taking action in both the short and long-term

The VCAPS report included information about how increasingly shallower groundwater tables are potentially impacting septic systems, and stormwater events that also reduce the vertical separation between the drain fields and groundwater tables. The VCAPS project included a strong stakeholder engagement process that utilized a diagramming process on topics to identify the hazard/stressor followed by the potential outcomes and ultimately consequences if nothing is done to address the hazard or stressor. The adaptation actions identified through community engagement were generally broken into five main categories: ocean management, estuarine shoreline management, stormwater management, water (ground/surface) management, and an “all issues” category in which the actions were identified by stakeholder groups. Based on the prioritization by stakeholders, key next steps for the town include maintain and expand the Septic Health Initiative, on-going monitoring of erosion rates, development of a comprehensive education and outreach program on resiliency and sea level rise, development of an estuarine shoreline management plan, and development of a plan for adaptation that includes a suite of sea level rise scenarios. In the Ground and Surface Water Management Diagram, VCAPS identified fecal coliform contamination due to reduced separations between the groundwater table and bottom of the drain field, which is critical to septic system treatment.

The VCAPS Report includes a prioritization table that listed several actions recommended for the town to implement in the coming years. Under Priority 1 there were two actions related to septic systems; 0-1 - Maintain and expand the Septic Health Initiative (retrofits, homeowner assistance, groundwater sampling, peer review data, groundwater mapping, transition towards mandatory inspections with other incentives); and 0-3 Develop a comprehensive education and outreach program for K-12, residents, and property owners implemented by both public and private actors. Include topics such as: SLR, storms, soundside/oceanfront erosion, beach renourishment, and CRS. Priority 2 included two recommendations related to septic systems; 0-11 Develop higher standards/regulations in permitting for separation of groundwater and mean high water below a septic drain field; and 0-15 Advocate for the continued enforcement of rigorous environmental health standards for septic systems. Under Priority 3, there was one action related to septic systems: 0-16 Explore the use of neighborhood scale design approaches. This could include utilization of off-site septic and cluster septic systems.

The feedback developed through the VCAPS report was used as the basis for development of policies and actions related to septic health, water quality, sea level rise, and hazards in the Comprehensive Plan. Additionally, stakeholder feedback was also utilized to develop a definition of resiliency. Resiliency in Nags Head means the Town and its residents:

- Withstand, respond to, and recover rapidly from disruptions without long-term damage to the economy or environment

- Require less government funding to recover, rebuild and redevelop its communities
- Sustain the way that natural systems provide ecosystem services that directly or indirectly support human survival and quality of life

The viability of using septic systems in Nags Head may be significantly impacted under future condition scenarios. Gaining a greater understanding of how OWTS will be impacted by future conditions is paramount as water quality is crucial to sustaining the Town's economy, environment, and quality of life.

9.6 Recommendations and Action Items

Below is a list of recommended actions:

1. Obtain additional groundwater table elevation data, through the use of remote groundwater loggers, across Nags Head to determine rise in groundwater tables (as outlined in Section 8.3)
2. Purchase remote groundwater data loggers and collect data at key locations where MSL is at or below 7-feet and groundwater tables are rising (as outlined in Section 8.3).
3. Develop a Nags Head/OBX climate model that studies future conditions to further determine impacts from increased precipitation, flooding, and groundwater on septic systems. This should include the development of a range of sea level rise scenarios.
4. Continue to incentivize installation of stormwater control measures (rain gardens, rain barrels, cisterns, permeable pavement, bioswales, planting trees outside of septic drain fields) on individual residential properties to aid in flooding reduction.
5. Reduce impervious surfaces at town owned facilities with surface retrofits (where possible) to decrease stormwater runoff through the OneWater initiatives.
6. Coordinate with NCDOT on increased carrying capacity in ditches and swales and installation of stormwater control measures in the state right of way where appropriate.
7. Preserve open space, conserve existing vegetation, and plant additional trees outside of septic systems and drain fields to aid in holding soil and absorb stormwater runoff.

SECTION 10.0

Septic System Planning Guidance

10.0 Septic System Planning Guidance

Section 10.0 Septic System Planning Guidance serves as a guide to the Town of Nags Head to aid in the planning and management of septic system suitability and viability based on current site conditions. This section also evaluates the potential for septic system failure and its associated risk to water quality and the surrounding environment based on current site conditions. Further, this section outlines future considerations for septic system planning to aid in determining criteria and a scoring metric for the development of effective wastewater treatment options for repairs, replacements, and new systems. These criterion can be used to evaluate the need for more advanced treatment as conditions change, hot spots grow, conventional septic systems are no longer viable, and risk increases.

10.1 Septic System Site Evaluation Criteria and Risk Assessment under Existing Site Conditions

As part of the Decentralized Wastewater Management Plan Update, a town-wide septic system risk assessment evaluation was conducted. This parcel-based geospatial data evaluation identified sites which are most susceptible to septic system failure and pose the greatest risk to environmental and human health (e.g., proximity to specific features such as surface waterbodies and stormwater infrastructure). For this analysis, the sites analyzed across Nags Head were single-family parcels not currently associated with community central sewerage systems (e.g., the Village). Sites were scored based on specific assessment criteria that were weighted for relative importance, with composite scores calculated as a function of relatively low, medium, or high risk. Resulting “hot spots” with medium and/or high risk can be targeted by the town in the future to conduct targeted outreach under the SHI program. Below is a more detailed description of low, medium, and high-risk criteria:

1. **Low Risk:** Site conditions support effective treatment of septic effluent, there is minimal risk of system failure, and there is low risk of water quality/environmental contamination due to septic system failure or transport of untreated septic effluent.

2. **Medium Risk:** Site conditions generally support treatment of septic effluent, but environmental factors may require use of advanced septic systems for successful long-term performance. The site could face additional risk in the future if SLR and rising groundwater elevations yield susceptibility to climate change. Water quality and environmental risks may or may not be impacted within 300 feet of water bodies but not to the extent that conditions would warrant a major neighborhood-wide septic system failure.

3. **High Risk:** Site conditions are not currently favorable to support treatment of septic effluent via conventional septic systems. Alternative treatment such as advanced or a decentralized cluster treatment systems that convey wastewater effluent to more suitable sites are likely needed within the near future. Water quality and environmental conditions are more likely to be impacted by septic failures in this category.

While the relative risk associated with any given combination of metrics can identify potential hot spots for targeted outreach, the specific site suitability and/or feasibility for mitigation of risk will require additional information and field-evaluation to determine which options for wastewater treatment may be the most appropriate for any given site. Sites with higher risk may require advanced treatment options for septic systems that may include use of approved technologies to improve efficacy and efficiency of wastewater effluent treatment. Specific system types are approved by NC DHHS EHS On-Site Water Protection

Branch (OSWP) and NC DEQ DWR and can be found on the NC DHHS EHS OSWP webpage under approved products.[30] Additional treatment options are also outlined in Appendix D. In general, advanced treatment systems may include but are not limited to: Advanced Treatment Units (ATU), Low Pressure Pipe (LPP), drip, recirculation/reuse onsite (grey water), recirculation/reuse offsite then either pump grey water to the water treatment plant, use as spray irrigation, or recirculate back to the home, and decentralized cluster systems. Additional treatment options are available in other states but are not yet accepted by NC DHHS EHS OSWP.

For the town-wide risk assessment analysis, the following are evaluation metrics that were selected based on data availability and likelihood of potential environmental and human health risk factors associated with a potential septic system failure: land surface elevation, depth to groundwater, proximity to stormwater infrastructure, proximity to surface water including all waterbodies, proximity to environmentally sensitive areas, and observed poor surface water quality. These analysis metrics and criteria are described in further detail below and summarized in Table 10-1.

1. Land Surface Elevation

The mean sea elevation or land surface elevation of any parcel provides a strong indication of current potential resiliency to flooding and potential change in groundwater table elevations and water surface elevation due to sea level rise. Low-lying areas are more at-risk to flooding from precipitation events, rising groundwater levels, and coastal storm surge than high-elevation areas. More about the land surface elevation and flood risk is described further in Section 0 of The Outer Banks Regional Hazard Mitigation Plan, adopted in 2020, and the NC Climate Science Report, revised in September 2020, both discuss how future conditions may affect the Town and region. These changing future conditions will need to be taken into consideration for the continued use of septic system treatment viability. Section 10 outlines septic system planning guidance for utilization of more advanced systems based on current onsite conditions, which may also be utilized for future conditions as the climate changes.

Sea Level Rise. Land surface elevation for each parcel was determined geospatially as the area-weighted average of an elevation raster which was developed from the QL2 LiDAR-based 1-foot resolution contour topography available from NC OneMap (Figure 10-1). Per the groundwater table elevation research conducted by ECU CSI, it was determined that a 7-foot mean sea elevation for individual parcels was the tipping point for the required 18-inches of separation between the bottom of the septic drain field and the groundwater table as outlined in 15A NCAC 18A .1950 regulations.[31]

Relative Scoring Thresholds:

- Land Elevation > 7 feet – Low Risk
- Land Elevation 3 - 7 feet – Medium Risk
- Land Elevation < 3 feet – High Risk

2. Depth to Groundwater

Depth to groundwater (or vertical separation distance between the land surface and the groundwater table) is one of the most critical metrics for determining risk and feasibility of septic management options.

[30] https://ehs.ncpublichealth.com/oswp/approvedproducts.htm

[31] 1900RulesApril2017.pdf (ncpublichealth.com), p. 21-22

This metric can also indirectly indicate the potential pathways for fate and transport of wastewater related contaminants into groundwater supplies. Data utilized for this metric is described further in Section 8.0 Groundwater and Subsurface Water Quality Data Analysis and Section 9.4 Groundwater Table Elevation Rise. Using the linear relationship identified between land surface and long-term average annual depth to groundwater, an area-weighted average depth to groundwater was approximated for each parcel (Figure 10-2). Regional groundwater monitoring cannot capture site-specific and regionally specific eccentricities in groundwater depth and represent a spatially continuous surface between observations. Additionally, groundwater table depth can vary significantly due to drought conditions, tidal patterns, seasonal fluctuations, and localized groundwater withdrawals or injections, so recall that these approximations are based on long-term average regional groundwater depths rather than site-specific data which would enhance this metric.

Relative Scoring Thresholds:

- Depth to Groundwater > 36 inches – Low Risk
- Depth to Groundwater 25 - 36 inches – Medium Risk
- Depth to Groundwater < 24 inches – High Risk

3. Proximity to Stormwater Infrastructure

When a septic system failure occurs in close proximity to existing stormwater infrastructure, the potential environmental and human health risk can be significant depending on the type of system failure, the distance to the infrastructure, and type of infrastructure nearby (Figure 10-3). For this metric, the town's existing geodatabase of stormwater infrastructure geospatial data was utilized to tabulate the relative overall risk of a site based on its proximity to specific types of features:

a) Surface Water Conveyance: storm drain points and storm virtual drain fields
b) Subsurface Conveyance: storm gravity mains and storm culverts
c) Inlet Features: storm inlets and storm manholes
d) Groundwater Lowering: network structures (groundwater lowering well project area)

Based on whether a parcel centroid is less than 300 feet away from any of the above features, relative scoring was assigned. If a site is within 300 feet of any of the above features, it is flagged with a "1" for feature types a through c, or with a "2" for feature type d as proximity to groundwater lowering wells place sites at more significant risk for groundwater contamination in the event of a failure.

Relative Scoring Thresholds:

- Count of Proximity Stormwater Infrastructure Feature Classes = 0 - 1 – Low Risk
- Count of Proximity Stormwater Infrastructure Feature Classes = 2 - 3 – Medium Risk
- Count of Proximity Stormwater Infrastructure Feature Classes = 4 - 5 – High Risk

4. Proximity to Surface Waterbodies

Septic systems located in close proximity to surface waterbodies are at risk of failure due to higher groundwater elevations (lower depths to groundwater), but they also pose higher potential environmental and human health risk in the event of failure due to potential ease of transport to open water. For this analysis, waterbody boundaries of interest were identified geographically around Nags Head as the estuarine shoreline to the northwest, the canals in the Cove, the inclusion of the fresh water ponds located on the eastern side of Nags Head Wood Preserve, the beach to the east, the canals located in the

Causeway along US 64, and Cape Hatteras National Sea Shore to the southwest. The distance of each parcel centroid to any waterbody features identified here was calculated for this metric (Figure 10-5).

Relative Scoring Thresholds:

- Distance > 25th percentile of all distances – Low Risk
- Distance 25th – 75th percentiles of all distances – Medium Risk
- Distance < 25th percentile of all distances – High Risk

5. Proximity to Environmentally Sensitive Areas

Septic systems located in close proximity to environmentally sensitive areas pose higher potential environmental risk in the event of failure. For this analysis, environmentally sensitive areas were identified as the "natural areas" from the North Carolina Natural Heritage Program which includes the geographic extent of Nags Head Woods, Jockey's Ridge, and the Bodie Island marsh area, as well as the inclusion of any wetland features (specifically estuarine and marine wetlands, freshwater emergent wetlands, and freshwater forested/shrub wetlands). For this metric, the distance of each parcel centroid to any of the features identified here was calculated (Figure 10-5).

Relative Scoring Thresholds:

- Distance > 25th percentile of all distances – Low Risk
- Distance 25th – 75th percentiles of all distances – Medium Risk
- Distance < 25th percentile of all distances – High Risk

6. Proximity to Poor Surface Water Quality

Based on observed surface water concentrations for nutrients and bacteria described in Section 8.0, septic systems near observed poor water quality may be contributing to observed impairment. Poor water quality sites were identified as surface water sampling sites which have either:

a) Median Nitrate – Nitrogen (NO_3^-) concentrations observed greater than 10 mg/L, per North Carolina water quality exceedance standards
b) Geometric mean Enterococci concentrations great than 35 colonies/100 mL, per US Environmental Protection Agency (EPA)'s recreational water quality criteria recommendations

Alternative thresholds could be used to identify poor water quality sites based on Fecal Coliform or *E. coli* observations, however the Enterococci dataset for Nags Head is the most robust, and it is the bacteria metric identified for indicating beach closures through the Shellfish Sanitation and Recreational Water Quality Division of NCDEQ. The proximity of any parcel to a known poor water quality site defined by the above criteria was tabulated. Proximity results were analyzed statistically to assign relative risk (Figure 10-5).

Relative Scoring Thresholds:

- Distance > 25th percentile of all distances – Low Risk
- Distance 25th – 75th percentiles of all distances – Medium Risk
- Distance < 25th percentile of all distances – High Risk

All of the above site evaluation criteria metrics are listed below with their relative risk, threshold values for analysis, and the overall importance of each metric as assigned by a relative "weight".

Table 10-1. Site Evaluation Threshold Values and Relative Risk

Site Evaluation Criteria	Weight	Scoring Threshold Value	Relative Risk
Land Surface Elevation (feet)	High	> 7	Low
		3 - 7	Medium
		< 3	High
Depth to Groundwater (inches)	High	> 36	Low
		24 - 36	Medium
		< 24	High
Proximity to Stormwater Infrastructure (count of proximity flags as < 300 feet away, by infrastructure type)	Medium	0 - 1	Low
		2 -3	Medium
		4 - 5	High
Proximity to Waterbodies (feet)	Medium	Distance < 25th percentile	Low
		Distance 25th - 75th percentile	Medium
		Distance > 75th percentile	High
Proximity to Environmentally Sensitive Areas (feet)	Low	Distance < 25th percentile	Low
		Distance 25th - 75th percentile	Medium
		Distance > 75th percentile	High
Proximity to Poor Surface Water Quality (feet)	Low	Distance < 25th percentile	Low
		Distance 25th - 75th percentile	Medium
		Distance > 75th percentile	High

These metrics were combined to generate a composite score or overall relative risk assessment for single-family residences on existing septic systems across Nags Head, with breakout maps zoomed into six different geographical areas across the town (Figure 10-6 through Figure 10-10). As indicated by the color ramp symbology, areas identified as purple have higher relative risk associated with septic system failure based on the site evaluation criteria outlined in this section, yellow represents medium risk, while areas identified as green have lower relative risk:

- Low Relative Risk: 1,512 parcels (42%)
- Medium Relative Risk: 1,787 parcels (48%)
- High Relative Risk: 428 parcels (11%)

The percentage of each total parcels in each risk class is compared to the total number of single-family residential parcels with onsite systems analyzed here (total count 3,727 parcels). The relative risk classification breakpoints were identified as a function of natural statistical breakpoints in the dataset. The areas of highest risk identified by the geospatial risk analysis are concentrated on the soundside of the town. The lowest risk areas are concentrated in northern Nags Head along the central area adjacent to US158. The highest relative risk areas as depicted in Figure 10-6 through Figure 10-8 are as follows:

- Soundside between Jockey's Ridge and the Village: W. Soundside Road, Southridge, Roanoke Sound Shores, Old Nags Head Cove
- South Nags Head – Parcels adjacent to the National Seashore west of S. Old Oregon Inlet Road (SR1243)
- Causeway Area – Pond Island and The Lone Cedar Village

Areas of high relative risk may be important for the following reasons:

- The town may seek targeted outreach and engagement of these parcels under the SHI program.
- These sites may require advanced levels of septic system treatment due to current or projected future onsite conditions (pending site-specific confirmation of key data such as existing septic system type and depth to groundwater).
- If large geographic areas are identified for potential high risk of failing septic systems, the town may consider opportunities to pursue State or Federal grants or loans outlined in Section 11.2 related to neighborhood-scale septic system replacement or implementation of community decentralized septic systems with offsite cluster treatment options.
- Identification of areas for future open space preservation, land acquisition, or consideration of FEMA buy outs for properties with repetitive losses due to flooding greater than 50% of the property value.
- Justification for additional groundwater elevation monitoring data using continual remote loggers to determine actual conditions in hot spots and develop seasonal averages.

Development of future condition scenarios based on the monitoring data, groundwater studies, and the North Carolina Climate Science Report is recommended to determine the probability of parcels moving from a low to medium risk or medium to high risk and update the management models accordingly. The hot spot risk analysis for single-family parcels with existing onsite systems is intended to help the town with decision-making related to mitigation of septic failures, reduction of both environmental and human health risk, and increasing community resiliency.

The relative hot spot risk analysis is only as robust as its data inputs, so increased data collection quantity and/or resolution related to long-term average groundwater depth (and the importance of seasonal and tidal fluctuations), surface water quality, and particularly parcel-specific data on system type, system age, and system operation would improve the accuracy and utility of the risk assessment tool.

Additionally, the risk analysis cannot capture site-specific locations which may be higher or lower risk due to environmental characteristics such as *unknown conditions*, like poor water quality that has not been observed, or *unexpected conditions,* like areas where on-site soil conditions are different from regional soil compositions, or areas where the relationship between depth to groundwater and land surface elevation may not be correlated linearly respite the regional trend.

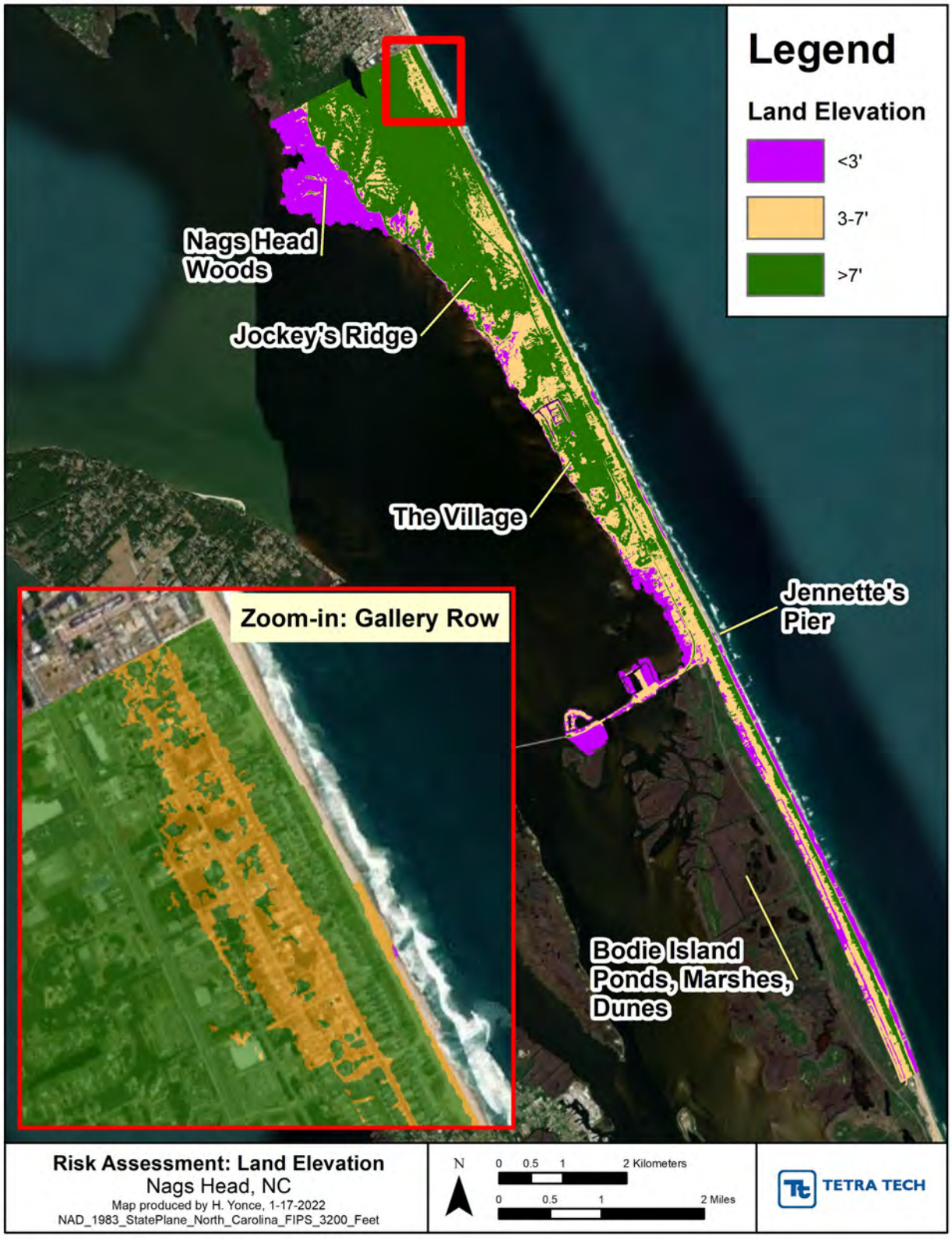


Figure 10-1. Land Elevation across Nags Head (binned by risk class)

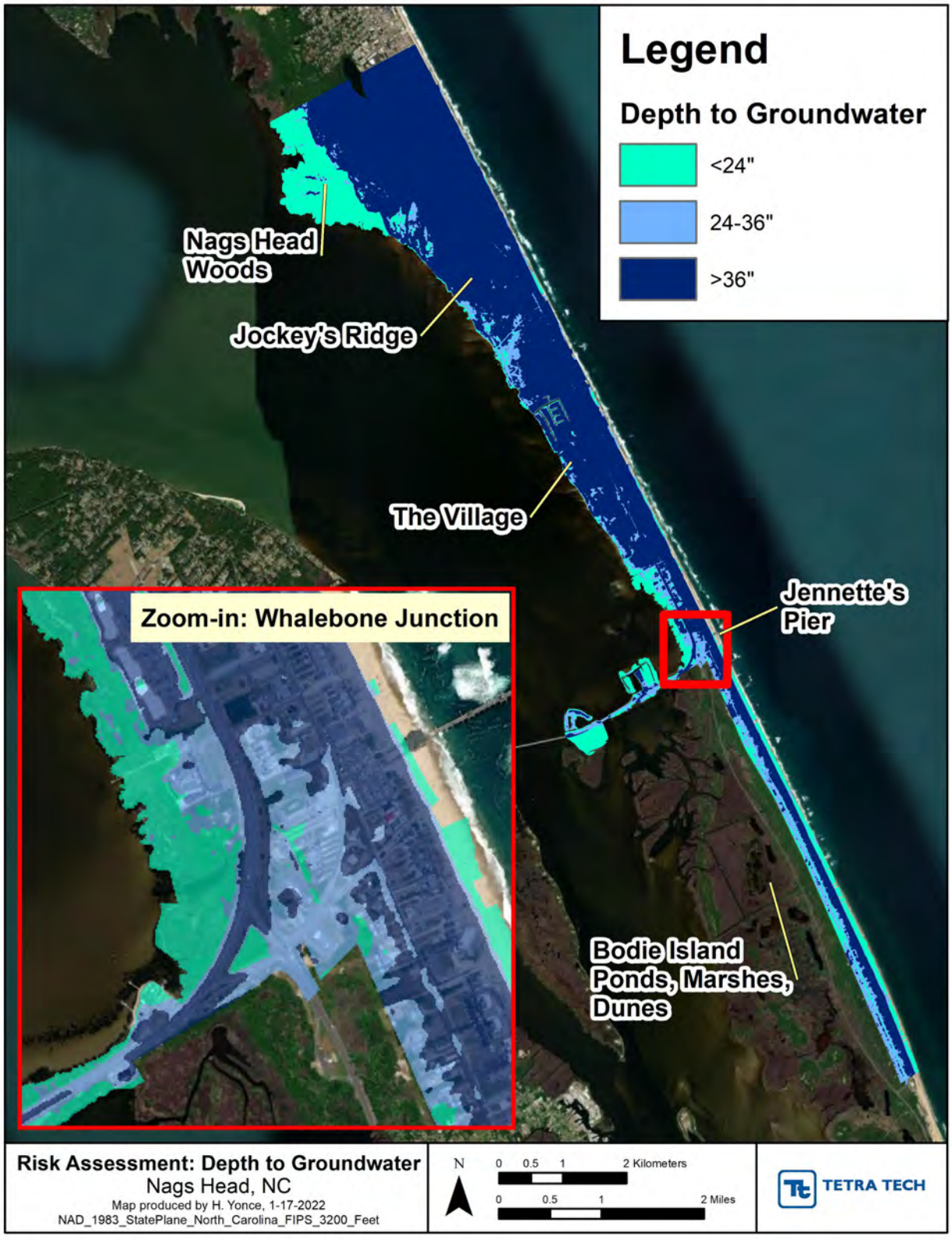


Figure 10-2. Depth to Groundwater across Nags Head (binned by risk class)

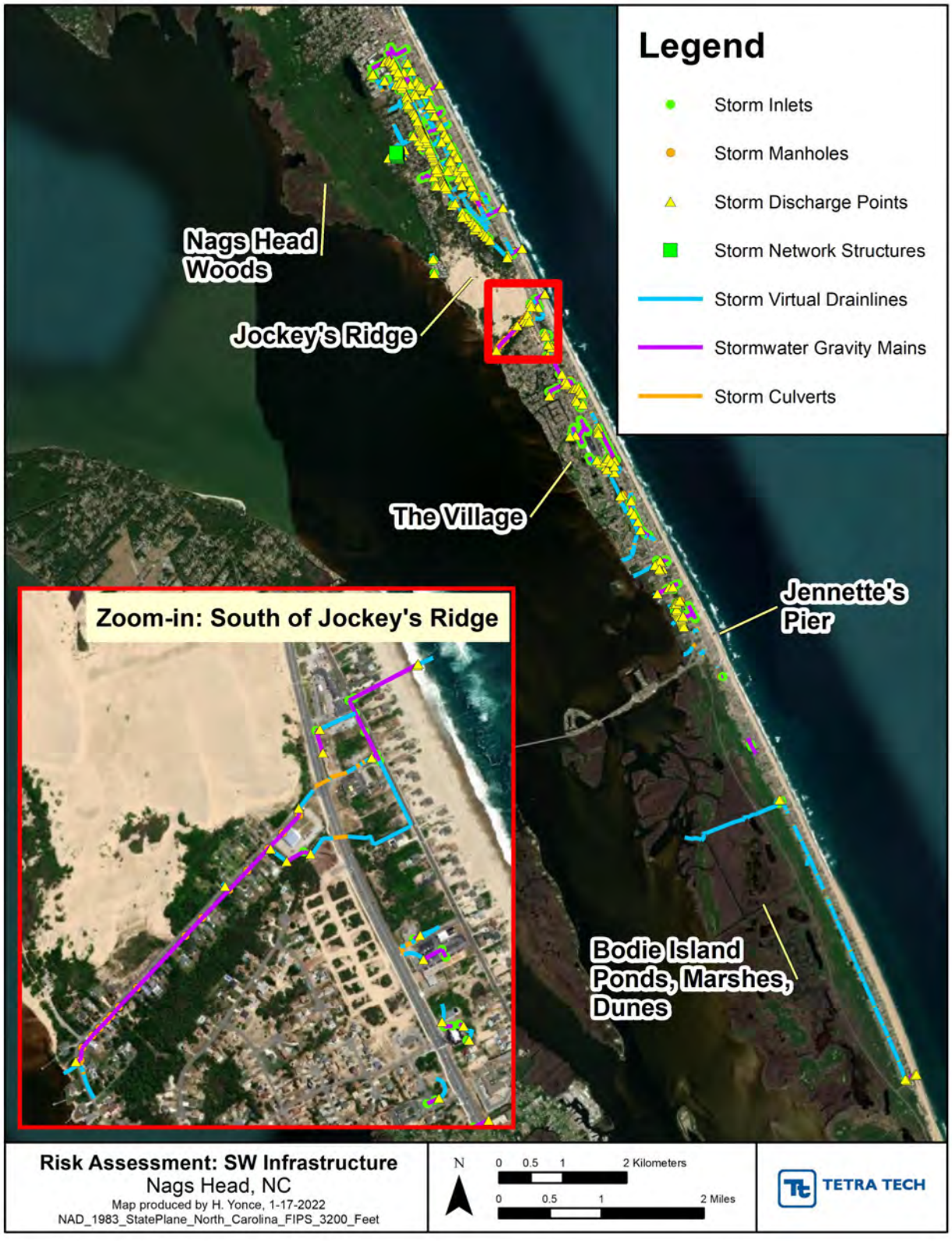


Figure 10-3. Stormwater Infrastructure Features for Risk Assessment

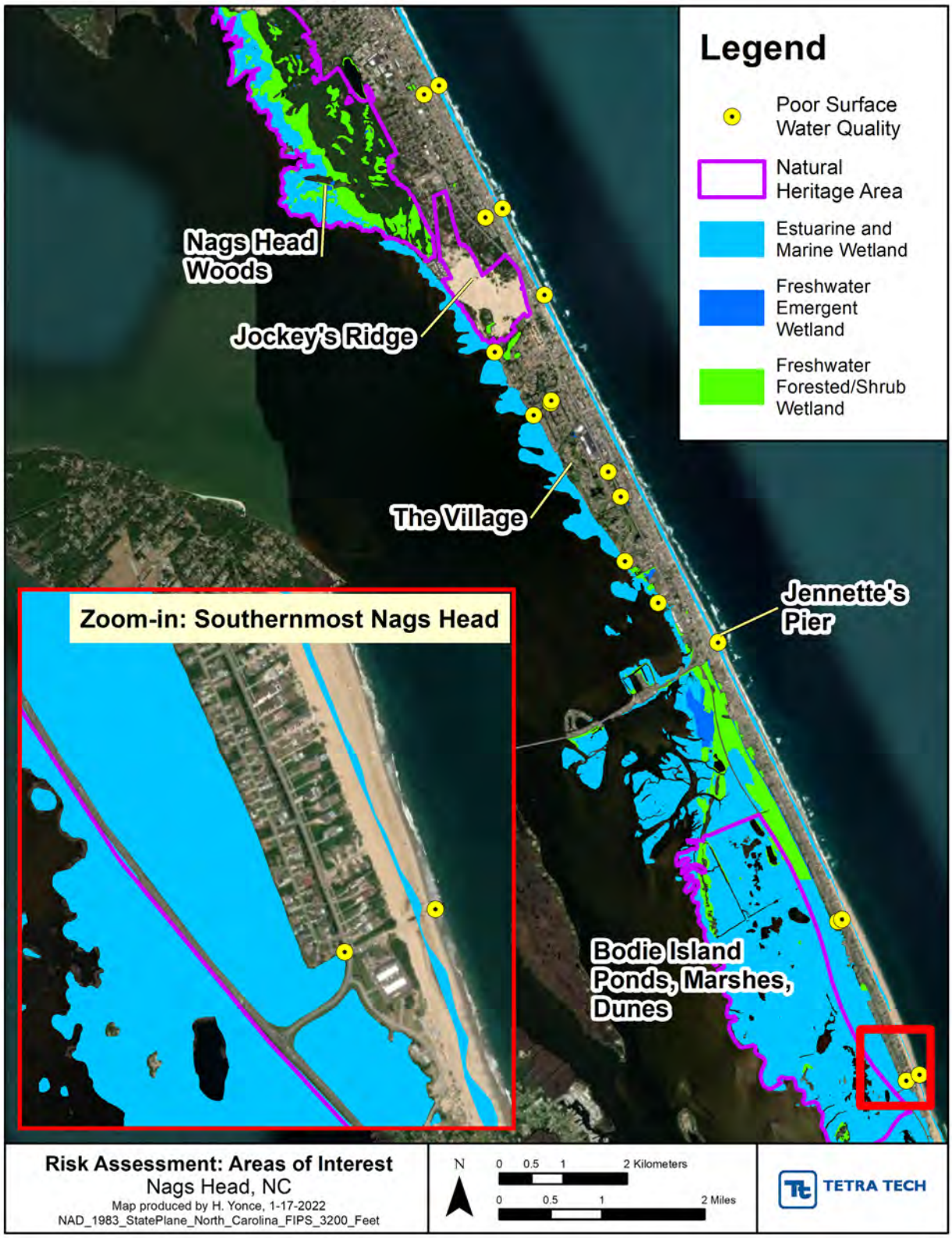


Figure 10-4. Waterbodies, Environmentally Sensitive Areas, and Poor Surface Water Quality Sites for Risk Assessment

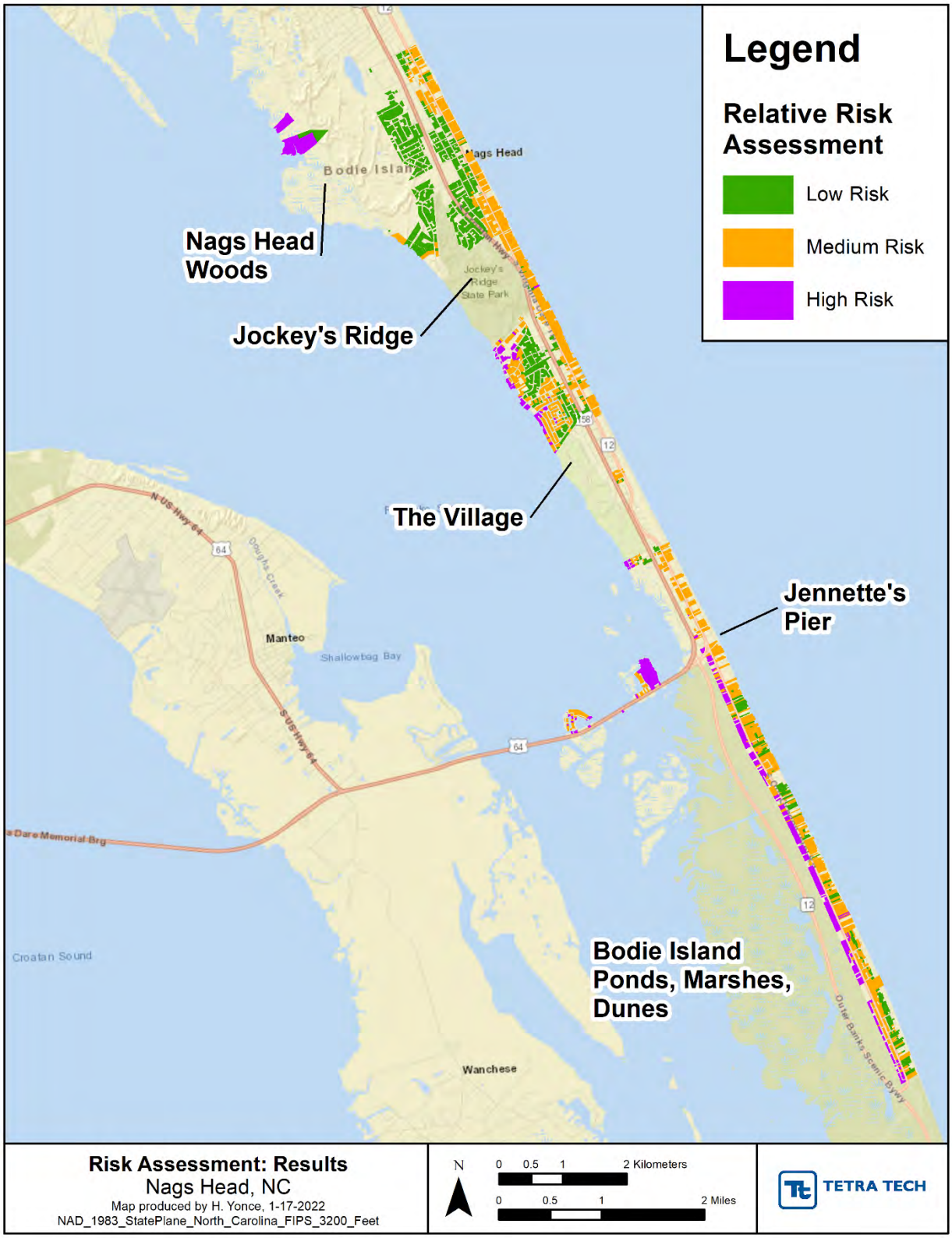


Figure 10-5. Overall Risk Assessment Results: Nags Head

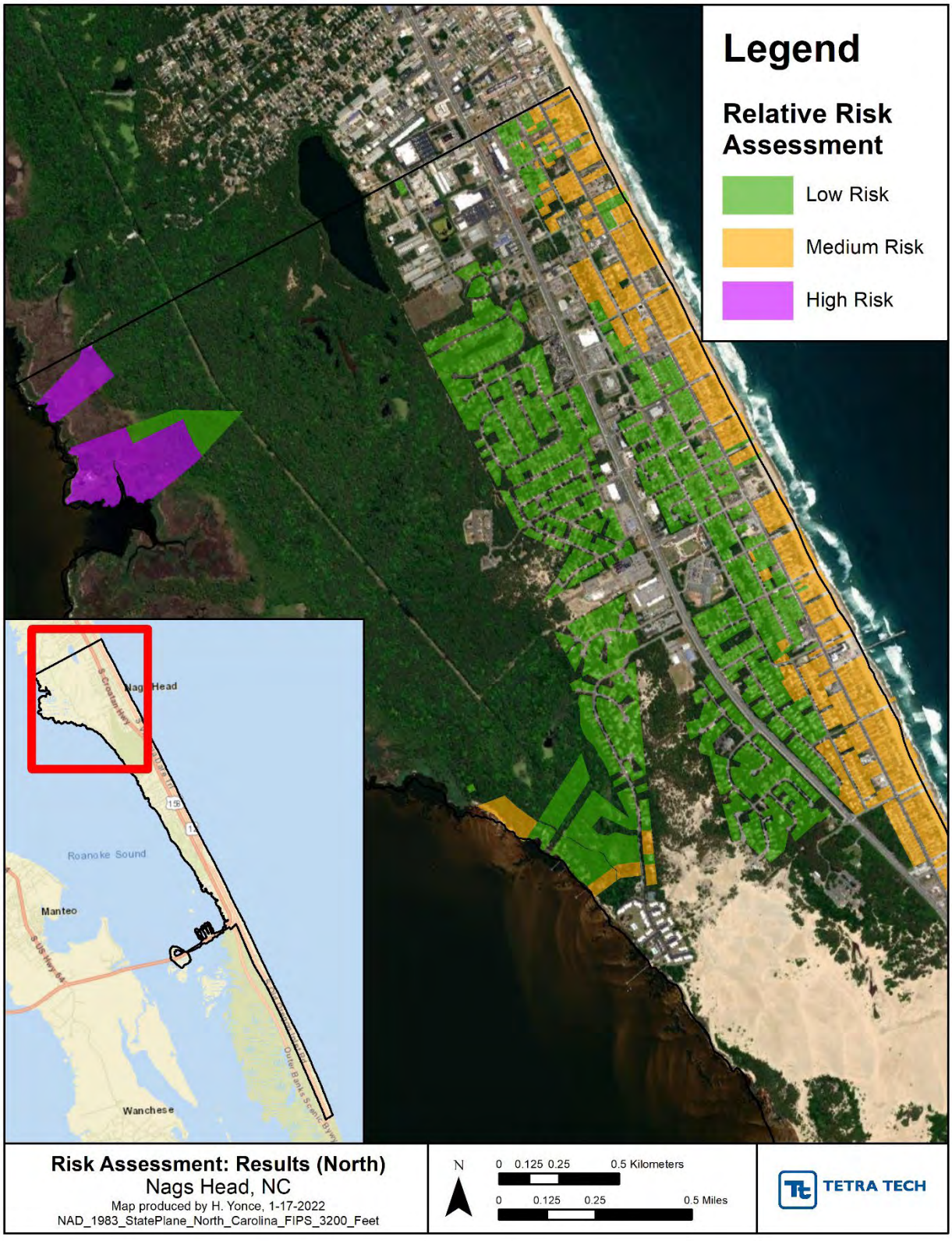


Figure 10-6. Overall Risk Assessment Results: Gallery Row Area (northernmost Nags Head)

Figure 10-7. Overall Risk Assessment Results: Jockey's Ridge Area (north central Nags Head)

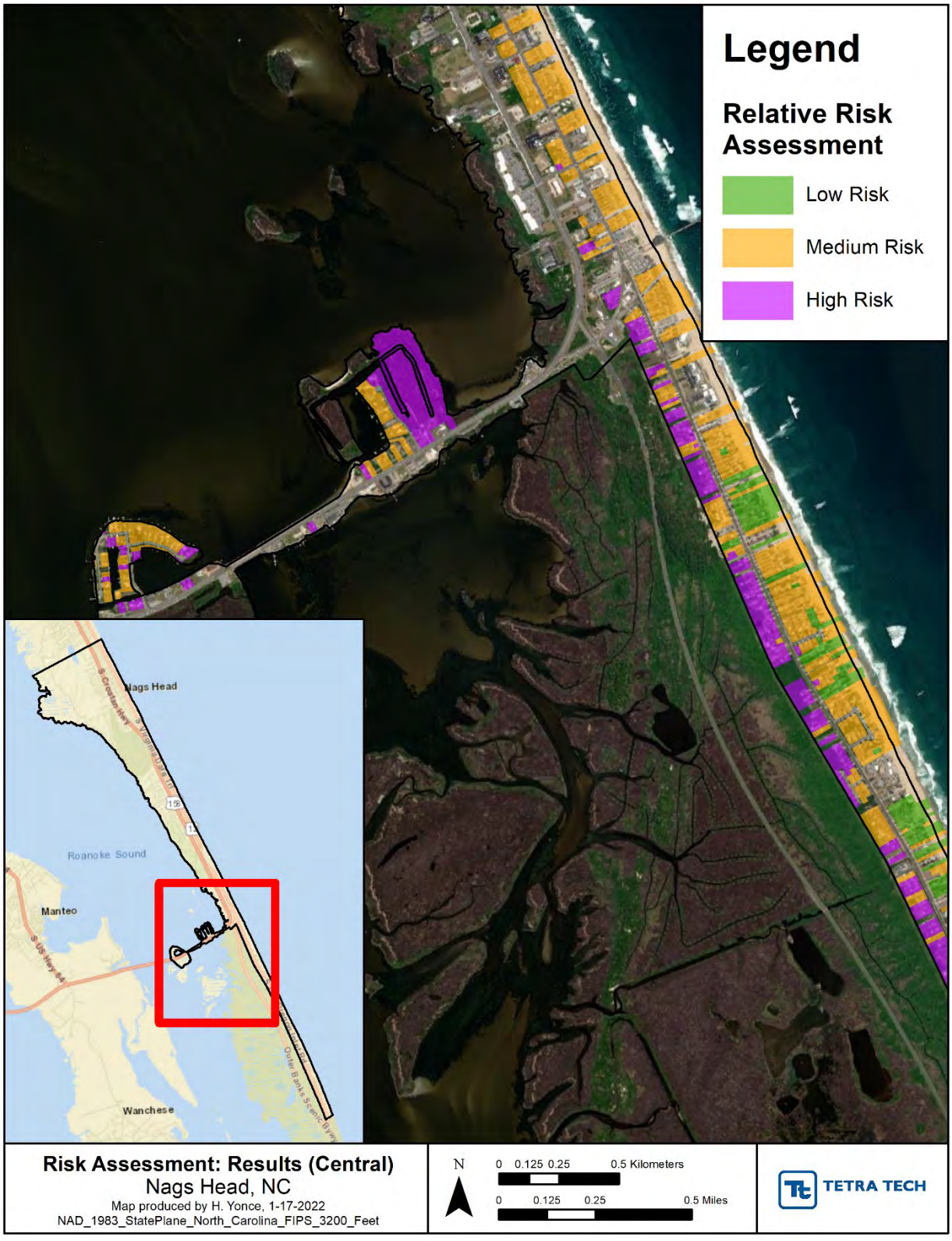


Figure 10-8. Overall Risk Assessment Results: Causeway/Whalebone Junction Area (central Nags Head)

Figure 10-9. Overall Risk Assessment Results: South of Jennette's Pier Area (south central Nags Head)

Figure 10-10. Overall Risk Assessment Results: Southernmost Area (southern Nags Head)

10.2 Future Planning for Septic System Repairs, Replacements, and New Systems

As risk for septic system viability increases from medium to high, additional planning for future conditions will be needed. A Long-Range Septic System Viability Master Plan (not included in the DWMP Update) could be developed to further refine the hot spot prioritization and need for septic system repairs, replacements, and treatment options under future condition scenarios. This Master Plan could also be used as a roadmap to aid the town in developing long-range septic system management and replacement options. Additional criteria can be added, analyzed, and evaluated to optimize management options for the town, which can incorporate engineering feasibility, project cost effectiveness, socio/economic considerations, and additional risk factors as conditions change or additional data is modeled over time. The resulting future Master Plan could also aid in additional SHI outreach to homeowners to conduct repairs or replacements or prioritize community-scale treatment systems with offsite management. Appendix D further outlines five (5) proposed management options and site evaluation/prioritization criteria that can be analyzed to geographically prioritize option implementation as part of a future Master Plan. These proposed options, which are listed below, include both onsite upgrades and neighborhood scale offsite treatment/dispersal systems. The management options would be permitted by either County or State regulatory agencies depending on system size and type.

Option 1: Residential LPP with mounded dispersal field (no pretreatment required)
Option 2: Onsite ATU Systems with conventional, drip, or LPP dispersal (native or modified soil)
Option 3: Onsite Reuse Quality Non-Discharge 2U Standards (NC DHHS) at grade dispersal w/ shallow drip
Option 4: Community Collection Sewer with Type I/II Non-Discharge Treatment System (NCDHHS Permit Review)
Option 5: Community Collection Sewer with Reuse Quality Non-Discharge 2U Treatment System (NC DEQ Permit)

Onsite systems (Options 1-3) ultimately depend on in-situ field measurements (e.g., soil texture, depth of suitable soil to restrictive layer) that will be permitted by the Dare County Health Department, although the town could support the funding and management of these advanced treatment upgrades. However, the town could be more involved in the planning, implementation, and management of offsite cluster systems (Options 4-5) by helping facilitate funding for capital expenses, allocation of public lands for system treatment, or serving the role as Responsible Management Entity (RME).

Appendix D also includes an example list of evaluation criteria for option prioritization in addition to those listed in Section 10.1. Additional criteria are listed below and in Table 10-2. With each management option, a relative scoring ranking is proposed for each evaluation criteria to help illustrate the logic supporting the geographical prioritization within the town. Similar to the risk assessment analysis presented in Section 10.1, the Master Plan prioritization could also be assembled as a spreadsheet-based tool with ability for the town to adjust weighting factors for each of the evaluation criteria.

1. Parcel Density
2. Parcel Size
3. Density of Failing Septic Systems – unknown, gap*
4. Age of Existing Septic System – unknown, gap*, estimate based on age of home and tax record/parcel data
5. Density of Existing Onsite Pretreatment Systems – unknown, gap*
6. Proximity to Publicly Owned Land or Open Space Areas
7. Future Conditions

**Septic permit data obtained from Dare County will be able to fill the gaps noted above*.

Note: Additional information associated with Dare County Environmental Health septic system permit records have not been able to be fully archived for septic systems within the town. Once data is obtained from Dare County, a review and revision to the evaluation criteria may be needed to incorporate additional data and criterion types.

Table 10-2. Future Septic System Evaluation Criteria

Evaluation Criteria	Threshold Value	Potential Parcel Scoring Criteria Point Value, Risk Rank
Parcel Density (acres)	Less Than 1 Home per Acre	10, Low
	1 to 2 Homes per Acre	5, Medium
	Greater Than 2 Homes per Acre	0, High
Parcel Size	Over 2 Acres	10, Low
	1 to 2 Acres	5, Medium
	Under 1 Acre	0, High
Density of Failing Septic Systems*	Less Than 2 Systems	10, Low
	Between 2 and 6 Systems	5, Medium
	Greater Than 6 Systems	0, High
Age of Existing Septic System*	20 Years or Less	10, Low
	20 to 50 Years	5, Medium
	Over 50 Years Old	0, High
Density of Existing Onsite Pretreatment Systems*	Greater Than 6 Systems	10, Low
	Between 2 to 6 Systems	5, Medium
	Less than 2 Systems	0, High
Proximity to Publicly Owned Land or Open Space Areas (County and City) for Cluster Decentralized System Types	Less Than 0.5 Miles	10, Low
	0.5 to 2 Miles	5, Medium
	Greater Than 2 Miles	0, High

*Dare County Data Needed

10.3 Recommendations and Action Items

The project team used the developed evaluation criteria and scoring matrix to run a lot-by-lot and area-wide GIS data analysis. This analysis identified areas of town where multiple limiting conditions exist, and where septic systems should be working adequately. Note that any off-site option recommendations would require additional engineering and hydrogeologic study beyond the scope of this Plan. All properties that are in areas of off-site recommendations are also provided on-site upgrades and management recommendations. Areas where conditions are very favorable for septic systems will be included in the overall education and outreach for managing their systems as efficiently as possible. Below are recommendations for under this section:

1. Obtain Dare County Environmental Health Septic Permit Data for all septic systems in the town's jurisdiction.
2. Add Dare County Septic Permit data (old and new) to a master spreadsheet database framework that was developed as part of this Plan and outlined in Section 7.5 Program Database Framework
3. Develop a septic system inventory including GIS locations for all onsite systems in the Town of Nags Head.

4. Obtain additional Nitrate Nitrogen NO_3^- water quality data, Enterococci bacteria data, and groundwater elevation data across town and in hot spot target areas as outlined within Section 7.4 Water Quality and Bacteria Data Analysis and Section 8.0 Groundwater and Subsurface Water Quality Data Analysis.
5. Review Dare County septic system permit data, once obtained, and add additional scoring criteria.
6. Target hot spot areas, based on recommendations in this section, for additional outreach under the SHI.
7. Update the Outer Banks Regional Hazard Mitigation Plan (HMP) annually to aid in identifying community septic risks and provide opportunities for grant funding.
8. Add septic systems as critical infrastructure in the HMP and develop a vulnerability assessment.
9. Develop future conditions scoring criteria based on the NC Climate Science Report, climate models, and regional studies (not developed as part of this Plan).
10. Develop a future Town of Nags Head Long-Range Septic System Viability Master Plan that further analyzes future conditions, additional site criteria, and develops a roadmap for long-range wastewater treatment options as conditions change within the Town of Nags Head (not developed as part of this Plan).

SECTION 11.0

Program Budget and Funding

11.0 Program Budget and Funding

In order to address septic needs and promote a healthy watershed with good water quality, a phased implementation of new septic health initiatives and funding will be required.

The town's annual budget for the implementation of the SHI has varied over the years. Currently, the SHI program is funded by the Town of Nags Head general fund and water fund. To supplement the town's funding, a wide variety of grants and loans are available to assist with septic system repairs, water quality improvements, stormwater controls, groundwater lowering, community resiliency, effective risk reduction, mitigation, and flood control. This section discusses those funding sources and recommended action items.

11.1 Town General Fund/Water Fund

In FY 2021 the SHI program, including staff funding, was allocated $143,636. As outlined in the SHI Recommendations noted above in Section 7.6 SHI New and Expanded Initiatives, additional funding will be needed to expand and add programmatic elements.

In the future, the town may need to explore a septic utility to aid in funding the program. A utility study to determine the costs needed to fund the program is recommended.

11.2 Grants and Loans

Grants and loans are available to fund portions of the program. Potential funding sources:

1. NC DEQ Viable Utility Reserve (VUR).
2. Drinking water and wastewater loans and grants.
3. Asset Inventory and Assessment (AIA) grant for $150,000 over three years can help identify system components and location, risk analysis, condition assessment, replacement/upgrade.
4. Merger Regionalization/Feasibility (MRF) grant for $50,000 over three years can be used to consolidate two or more water/sewer systems, create a regional treatment, shared management, or public private partnerships (P3).
5. Clean Water State Revolving Fund (CWSRF) applications accepted twice per year in April and September. Under the program low-interest loans are available up to $30 million and 0% interest loans are available for Green Projects for rehabilitation projects for certain local government units.
6. Drinking Water State Revolving Fund (DWSRF) applications accepted twice per year in April and September.
7. NC Land and Water Fund (LWF) grant applications are accepted once per year in February and fund water quality/stormwater and land acquisition type projects.
8. FEMA Building Resilient Infrastructure and Communities (BRIC) grant sub applications are through NC Department of Public Safety Emergency Management (NC DPS EM) for Planning/Project Scoping through the Capability and Capacity Building (C&CB) grant through the State and construction grants through a full national competition. BRIC is a new program from FEMA that replaces the Pre-Disaster Mitigation (PDM) grant program in 2020. This program focuses on community resilience using a variety of tools including multiple community lifelines, partnerships, nature-based solutions. The 2021 grant funding allocation is $1 billion for the

national competition for construction projects with a maximum grant ask of $50 million per project.[32] In 2021, the State of North Carolina will be allocated $1 million for C&CB project scoping or planning projects including regionalization, cluster systems, and large-scale planning to increase community resiliency.

9. FEMA Flood Mitigation Assistance (FMA) sub applications are through NC Department of Public Safety Emergency Management for flood mitigation projects and structure buy-outs.
10. Community Development Block Grant – Infrastructure (CDBG-I) applications accepted once a year in September.
11. NC Department of Justice (NCDOJ) Environmental Enhancement Grant (EEG) is a grant program that funds that improve air, water, and land quality in NC. Grant letters are due in May of each year and awards are up to $500,000. [33]
12. NC Department of Environmental Quality (NCDEQ) Water Resources Development Grant.
13. Southeast Rural Community Assistance Project, Inc. (SERCAP) is a 501(c)(3) nonprofit organization focused on improving the quality of life for low-to-moderate income (LMI) individuals living in the Southeast United States. Since 1969, when SERCAP first brought clean, safe drinking water to low-income rural residents of Virginia's Roanoke Valley, the agency has grown into an organization directly responsible for providing safe water, sanitary water disposal, and structurally sound housing to well over a million households across its seven-state service region. SERCAP provides low-interest loans for onsite septic systems.
14. In 2021, the American Rescue Plan Act (ARPA) allocated funds to communities that must be committed by 2024 and spent by the end of 2026.
15. H.R. 3684 Infrastructure Investment and Jobs Act passed in 2021 at over $1.2 trillion in funding with $550 billion going to national infrastructure. The Infrastructure Act has the potential to address climate change, including strategies to reduce the climate change impacts of the surface transportation system and a vulnerability assessment to identify opportunities to enhance the resilience of the surface transportation system and ensure the efficient use of federal resources.[34]

Table 11-1. Traditional wastewater infrastructure grants

Program	Project Type	Funding Source	Typical Annual Funding	2021/2022 Draft State Budget
CDBG-I	DW & WW	Federal; amount set by NCGA	$25 million	$5M
DWSRF	DW	Federal SRF & State Reserve	$100 million loan	$300M (at-risk) + $600M (other)

[32] Building Resilient Infrastructure and Communities | FEMA.gov

[33] Environmental Grants - NC DOJ

[34] H.R.3684 - 117th Congress (2021-2022): Infrastructure Investment and Jobs Act | Congress.gov | Library of Congress

Program	Project Type	Funding Source	Typical Annual Funding	2021/2022 Draft State Budget
CWSRF	WW	Federal SRF & State Reserve	$150 million loan	+$100M (stormwater)
AIA	DW & WW	State Water and Wastewater Reserve	$10 million (recurring appropriation)	$80M
MRF	DW & WW			
VUR	DW & WW	State Viable Utility Reserve	$9 million (one time appropriation)	$500M

Table 11-2. Non-traditional wastewater funding. focused watershed, water quality, and infrastructure funding sources

Grant Funding Opportunity & Other Sources	Due Date	Maximum Ask	Match %
NC DEQ EPA 319(h) Grant	Early May	No Cap, Average $300,000	60/40
NC DEQ EPA 205(j) Grant	Applications: Mid-Sept.	No Cap, Average $18,000	None
NC DEQ Land & Water Fund (LWF)	First Monday in February	$600,000	None, 60/40, 75/25
NC DEQ Water Resources Development Grant (WRDG) NRCS EQIP	Spring: June 30 Fall: Dec. 31	$200,000	50/50
NC DOJ Environmental Enhancement Grant (EEG) Smithfield Agreement	LOI: Mid-May Application: June	$500,000	50/50
FHWA/NCDOT Locally Administered Project Program (LAPP) – BikePed, Roadway, Transit	Oct. 31	Varies	80/20
NC State Parks - Parks and Recreation Trust Fund (PARTF) for purchase of open space and development of parks. *Note: this grant may be used to retrofit spaces for mitigation or potentially clustered decentralized wastewater treatment in conjunction with recreational facilities.	Early May	$500,000	50/50
HUD's Community Development Block Grants - Mitigation (CDBG-MIT) and Infrastructure (CDBG-I)	Rolling Basis	$1,000,000	
American Rescue Plan Act (ARPA) of 2021	NA	Federal Disbursement	NA
FEMA Hazard Mitigation Grant Program (HMGP)	After Presidential Declared Disaster	20% of Declaration	75/25
FEMA Flood Mitigation Assistance (FMA)	LOI: October 1 Application: January 28	$900,000 Scoping/$30M flood mitigation project	75/25, 90/10 for small communities

Grant Funding Opportunity & Other Sources	Due Date	Maximum Ask	Match %
FEMA Building Resilience Infrastructure in Communities (BRIC) program - C&CB, Mitigation (through NC DPS EM)	LOI: October 1 Subapplication Due: January 28	$600,000 State $5,000,000 National	75/25, 70/30*
NC Clean Water State Revolving Fund (CWSRF) - Low/No Interest Loan	Training: July 27-Aug 5 Application: Sept. 30	$30,000,000	Loan

11.3 Recommendations and Action Items

One-time purchases of equipment like ISCO or YSI remote water quality data loggers and remote groundwater data loggers could be purchased in phases under general fund allocations or with the aid of a grant to cover the cost and a long-term study. ISCO remote water quality data loggers are estimated at $5,500 each and ISCO groundwater data loggers are estimated at $2,185 each.
Additionally, outside revenue may be available to the town through a variety of grant funds to also assist with pump out rebates and septic replacement loans. Grant sources are identified in Section 11.2.

Below is a list of recommendations for funding:

1. Provide annual funding and staff or contract services necessary to meet the goal of conducting 500 septic inspections annually.
2. Provide an annual budget to fund 250 septic system pump out rebates to homeowners.
3. Revise the pump out rebate from $45 to $150, review and revise as necessary after FY 2027.
4. Provide funding and staff necessary to expand surface water quality to capture Nitrate Nitrogen and Enterococci bacteria testing to obtain a larger set of data on a weekly basis.
5. Purchase remote water quality data loggers at $5,500/each.
6. Purchase remote groundwater data loggers at $2,185/each.
7. Install ten (10) groundwater monitoring wells across Nags Head to determine long-term seasonal and average groundwater levels.
8. Obtain a grant or funding to scan and catalog Dare County Environmental Health septic permit data into master Excel database and input into GIS to view data on a map.
9. Prepare monthly and/or annual reports to track goal progress.

SECTION 12.0

Summary and Conclusions

12.0 Summary and Conclusions

The Town of Nags Head relies on decentralized wastewater treatment (septic) systems that are operated and maintained by individual property owners. Since 1999, the Town has implemented a Septic Health Initiative (SHI) which includes offering system inspections, pump out rebates, low-interest loans and water quality monitoring of several groundwater and surface water sites. This Decentralized Wastewater Management Plan Update (the Plan) includes a detailed data analyses of various pieces of data and information on program elements, Advisory Committee and stakeholder engagement meetings, coordination with other Town initiatives, and recommendations for improvements. The following is a summary of the main components of the Plan.

Section 3.0 Community and Stakeholder Engagement: The Plan update was undertaken with early and often stakeholder and community involvement to identify and highlight what has worked well, has changed, and needs improvement relative to the original 2005 DWMP. The Town formed an Advisory Committee which met monthly to hear updates and provide input to the Project Team. Additionally, many stakeholder meetings were held with different professionals including property managers, realtors, business and environmental groups, and designers and service providers. One of the major conclusions was that there was broad support for the SHI and interest in the Town expanding its services. Stakeholders provided key recommendations that were further explored and integrated into the Plan.

Section 4.0 Vision, Mission, Goals, and Objectives: The purpose of the Decentralized Wastewater Management Plan (the Plan) is to develop a septic management plan to protect the quality of life by managing the town's decentralized wastewater resources to protecting the quality of the town's groundwater and surface water.

This plan will:

1. Be the professional resource for property owners and visitors on all things septic.
2. Protect residential and small business property investments.
3. Monitor critical environmental water quality resources to protect public health.
4. Ensure continual program support for the DWMP and SHI by developing an internal workplan that addresses and accounts for annual programmatic financial needs, staffing needs, resources, and outreach materials to meet the items identified under the SHI.

Ensure continual program support for the DWMP and SHI by developing an internal workplan that addresses and accounts for annual programmatic financial needs, staffing needs, resources, and outreach materials to meet the items identified under the SHI

The Plan is intended to be a community resource for onsite wastewater treatment information, aid in the protection of property investments across town by monitoring and providing analysis of environmental and public health data and provide continued support of the Septic Health Initiative.

Section 5.0 Relationship with Other Town Services, Plans, and Programs: There is a direct relationship between the Plan and various town departments including Planning, Engineering, and Water Services. The Plan is inextricably linked to programs for water conservation, stormwater management, risk assessment, response, and mitigation. The Plan evaluated residential and commercial water use versus estimated design flows and identified properties with high water usage. Stormwater infrastructure in town was identified and used in the risk assessment. Flood hazard mapping was also compiled into the risk assessment.

Section 6.0 Onsite Wastewater Treatment System Background: Informative background on septic systems is provided in the Plan, including State design and operation requirements, soil regulations, requirements, and types of systems across town. Descriptions of the various onsite septic system types and technologies available ranging from conventional to advanced treatment and water reuse were outlined to allow for greater understanding of systems overall. Additional information was provided regarding advanced treatment and its use to overcome limitations due to lot size and separation to various features, groundwater elevations in relation to the vertical separation distance requirements in the regulations, and system design flows.

Section 7.0 Todd D. Krafft Septic Health Initiative (SHI) Program Evaluation: The SHI program in its entirety was reviewed to evaluate program performance, engagement, incentives, and value provided to homeowners. While the program is popular, there is limited participation from homeowners in the inspection and rebate portions of the program. Recommendations to strengthen the program include expanded incentives for septic system proactive management, and increased awareness education for homeowners, renters, and visitors on how residential water use and septic systems relate to environmental and human health impacts. Future management options are described, such as the creation of a voluntary subscription service to provide certain wastewater services to homeowners for onsite maintenance and management assistance (system inspections, recommendations or arrangements for tank pump outs, repairs, or replacement, and opportunities for grants and loans).

Resulting SHI program evaluations identified that there are approximately 3,900 single-family small septic residential properties in Nags Head, mostly containing conventional septic systems. Since 2005, 2,330 owners participated in the free system inspection program, 423 different property owners have received septic pump out rebates with some receiving multiple inspections and rebates, and 133 have received a low-interest loan for repairs or replacement systems.

The Town collected water quality data from twenty-three (23) sites in Nags Head, spanning sixteen surface water sites, five ocean outfalls, and seven groundwater sites. Water quality data was analyzed for the 2011 to 2020 time period and included nutrients (nitrate nitrogen (NO3-), ammonia (NH3), total phosphorus (TP) and bacteria (fecal coliform, Enterococci, and *E. coli*). Concentrations of TP and NH3 were variable across and within sites, with no clear spatial pattern. NO3- concentrations tended to be highest at more southern sites in Nags Head, with sites that experienced exceedances of the North Carolina water quality standard of 10 mg/L (North Carolina Administrative Code, 2021) located in Old Nags Head Cove, Bypass, and Juncos sites. Exceedances of the NO3- standard were found at both surface and groundwater sites.

Based on the data collected by the Town, nutrient water quality was variable across surface and groundwater sites and across indicators. Two sets of indicators suggested sites with elevated water quality issues that may serve as targets for decentralized wastewater improvements in the future. The Bypass South surface site and the Juncos Well 1 groundwater site were flagged as high nitrate nitrogen sites, where both sites had median nitrate nitrogen concentrations exceeding 10 mg/L.

Enterococci bacteria were sampled regularly in surface waters from 2011-2020 and sporadically in groundwater sites. Concentrations were compared to the Environmental Protection Agency (EPA)'s recreational water quality criteria recommendations (U.S. Environmental Protection Agency, 2012), which include a geometric mean of 35 colonies/100 mL and a statistical threshold value (90th percentile) of 130 colonies/100 mL. Note that the locations sampled in Nags Head are not necessarily designated for primary contact recreation; thus, the comparison to the geometric mean and 90th percentile may not be applicable for assessment purposes but may serve as a useful point of reference. Exceedances of the

Enterococci criteria (geometric mean and 90th percentile) occurred in most surface sites and were more common in soundside sites.

Exceedances of the *E. coli* bacteria sampling criteria were common in surface water sites but not observed in groundwater sites. In surface water sites, geometric mean values exceeded the standard at Mile Post 10.5 Outfall, Soundside Outfall, Old Road, Harvey Tract, and South Nags Head Ditch. 90th percentile values exceeded the standard at all surface sites except Old Nags Head Cove Canal.

Combined bacterial indicators of Enterococci and *E. coli* showed that all surface sites had an exceedance of the 90th percentile EPA values for either or both metrics, whereas no groundwater sites were flagged for these indicators.

Section 8.0 Groundwater and Subsurface Water Quality Data Analysis: As part of the North Carolina Sea Grant, Climate Change and Onsite Wastewater Treatment System on Coastal Carolinas research being conducted by East Carolina University Coastal Studies Institute (ECU CSI), research is underway to evaluate existing onsite wastewater technologies under multiple climate conditions in the coastal Carolinas. East Carolina University Coastal Studies Institute compiled and analyzed groundwater elevations to understand the nexus of existing and projected groundwater and sea level elevations, and subsurface water quality (nutrients and bacteria).

Groundwater levels in Nags Head were found to vary based on the seasonal dynamics of precipitation inputs, evapotranspiration, ocean levels, and estuary water levels. The groundwater levels measured by ECU are rising at a rate of approximately 2 inches per decade (tracked since 1980). In areas where the groundwater table is less than 3.5 feet deep (currently or in the future), conventional septic systems are likely to be unsuitable for adequate wastewater treatment without modification.

ECU CSI also looked at groundwater quality directly below three existing septic systems in Nags Head. Wells for groundwater monitoring were installed between the trenches of the septic system drain fields serving Dowdy Park (DP), the Town of Nags Head municipal building (MB), the Bonnet Street (BS) beach access, and a private residence in South Nags Head (SNHR). Wastewater samples from the septic tanks and groundwater samples from the monitoring wells were collected 9 times between January 2020 and December 2021 for nitrogen, phosphorus, and *E. coli* analyses as well as recording the depth to groundwater.

Nitrogen in groundwater near the drain fields at DP, BS, MB was mostly (> 82%) NO3, indicating that the nitrification process (conversion of NH4 to NO3) was occurring in the > 2 ft vadose zone at those sites. However, the septic system serving the residence at South Nags Head (SNHR) experienced groundwater inundation of the trenches or within 0.1 ft (1.2 inches) during each sampling event.

The median concentrations of phosphate (PO4-P) in groundwater below the drain fields of the septic systems were between 82.4% and > 99% lower relative to concentrations in wastewater sampled from DP, BS, and MB, indicating high reductions in concentrations. However, the residential septic system in South Nags Head was discharging wastewater with a median PO4-P concentration of 8.45 mg L-1 directly to groundwater during the sampling events.

The median concentrations of *E. coli* bacteria in groundwater beneath the septic drain fields at DP, BS, and MB were each less than 3 MPN 100 mL-1. The highest concentration of *E. coli* in groundwater reported for the BS (70 MPN 100 mL-1), DP (36 MPN 100 mL-1), and MB (16 MPN 100 mL-1) sites were still at least 3 orders of magnitude lower than wastewater sampled during those events. The SNHR site was discharging wastewater with a median *E. coli* concentration of 185,000 MPN 100 mL-1 directly to

groundwater. Thus, at this site there was no opportunity for filtration or adsorption of *E. coli* in the soil beneath the system due to insufficient vertical separation.

Section 9.0 Future Conditions: Understanding the role of a changing climate, and how increases in rainfall intensity and frequency, sea level rise, and various types of flooding (groundwater, surface water, coastal) impact septic system performance and viability in preparing for community resiliency. More extreme storm events and rising sea elevations combined with groundwater elevation rises can negatively affect wastewater treatment in and under the drain fields. The NC Climate Science Report identified several scenarios that the town needs to consider for the long-term viability of septic systems in the future.

Section 10.0 Septic System Planning Guidance: A risk assessment based on site evaluation criteria were used to identify areas of town with higher risk of septic system failures, along with future planning options for the town's consideration. Results from data and geospatial analyses were used to identify areas of high, medium, and low environmental and public health risk and potential failure. Areas identified as high risk may require targeted outreach and consideration of off-lot community cluster wastewater treatment systems.

Section 11.0 Program Budget and Funding: Compilation of key funding sources and opportunities for both traditional and non-traditional wastewater infrastructure from state, federal, and non-profit entities was provided.

Throughout the Plan, there are data summaries, analyses, and recommendations for action items to enhance or improve existing data quality, data quantity, program performance, community engagement, problem-solving, and more. Table 12-1, below, is a prioritization of recommendations that lists the priority actions, the estimated timeline, potential funding sources.

The Plan also includes development of a robust Excel data management tool that the town can use for collecting future data, improving existing datasets, analyzing local risk, and future planning and development decisions. This tool can also be used to collect and analyze the septic permit data from the state and Dare County Environmental Health Department, which continues to be an important source of septic system data for inventorying and assisting in management activities.

The current DWMP and SHI are a robust program that assists homeowners with septic maintenance. The DWMP and SHI program are unique. No other coastal community provides services to homeowners to ensure proactive maintenance and improved water quality. During the stakeholder interview with Dare County, staff had said "They wished more communities would be proactive like the Town of Nags Head in developing robust septic and stormwater programs that protect the environment."

The data presented within this report is a thorough analysis of the DWMP and SHI that investigated all aspects of the program. The program's success depends on the town's commitment to improved water quality through proactive septic system maintenance.

12.1 Prioritization of Recommendations

Initial action items that can be completed in the next year are as follows:

1. Obtain septic system records from Dare County
2. Collect new septic information as new permits are issued through building inspections
3. Provide septic system location, age, and size information to homeowners via an online GIS platform
4. Continue to build and update Excel database that links information to the parcel number. This will allow for ease of use and tracking the determine recent septic system inspections, pump out rebates, and system repairs/replacements. The Excel database can also have pivot tables and macros to help query data for reporting purposes
5. Form Voluntary Septic System Committee to determine program details
6. Apply for grants for DWMP and SHI program incentives, data collection, GPS location of all septic systems, and targeted community system repairs
7. Focus water quality sampling on nitrate nitrogen (NO_3^-)
8. Focus bacteria sampling on Enterococci

Below is a list of additional action items prioritized by importance and year:

Table 12-1. DWMP and SHI action item prioritization list

Item	Priority	Action Item	Timeline	Potential Funding Resources	Section Reference
1	1a	Purchase ten (10) remote groundwater loggers and six (6) remote water quality loggers. Install at locations identified within this Plan.	Next 2 years	NC DEQ 319(h), FEMA BRIC, NC LWF, NCDOJ EEG, NC DEQ WRDG, NC DEQ DWI	8.3
2	1b	Implement a Voluntary Septic System Subscription Service.	Next 2 years	NC DEQ DWI	7.6.2
3	2a	Provide additional education and materials to high-risk areas and in general to homeowners including Septic 101 via town webpage, social media, YouTube Videos, links to EPA Septic Smart, inspection program, pump out rebate incentive increase, loan program.	Next 2 years		3.0, 7.6.3, 7.7
4	2b	Expand timing and staffing/contract services for septic system inspection program to meet goals and off-season periods.	Next 2 years	NC DEQ DWI	7.1, 7.7
5	3a	GPS locate all residential septic systems at time of inspection and input into Excel	Next 5 years	NC DEQ DWI AIA	5.5, 10.3

Item	Priority	Action Item	Timeline	Potential Funding Resources	Section Reference
		database and onto a GIS platform for others to view.			
6	4a	Set a goal of completing 500 septic system inspections annually by FY 2027.	Next 5 years		7.1, 7.7
7	4b	Set a goal of 250 septic system pump outs rebated annually by FY 2027.	Next 5 years		7.2, 7.7
8	1c	Increase the septic system pump out rebate.	Next 5 years	NC DEQ DWI	7.2, 7.7
9	5a	Increase septic system repair/replacement maximum loan amount.	Next 5 years	NC DEQ DWI	7.3, 7.7
10	6a	Add six (6) water quality monitoring locations and increase water quality sampling frequency.	Next 5 years	NC DEQ 319(h), FEMA BRIC, NC LWF, NCDOJ EEG, NC DEQ WRDG, NC DEQ DWI	7.4.1, 7.7
11	6b	Increase bacteria testing in conjunction with water quality sampling.	Next 5 years	NC DEQ 319(h), FEMA BRIC, NC LWF, NCDOJ EEG, NC DEQ WRDG, NC DEQ DWI	7.4.2, 7.7
12	7a	Identify high water users based on occupancy and annual average for potential leaks or septic failures. Provide follow up call/email to homeowner if a property is red flagged for a leak.	Next 5 years	NC DEQ DWI	5.2, 5.5
13	8a	Conduct a study to determine if a future Septic System Utility is warranted.	Future	NC DEQ DWI	7.7
14	6c	Develop a Nags Head/OBX climate model that studies future conditions to further determine impacts from flooding and groundwater on septic systems.	Future	NC DEQ 319(h), FEMA BRIC, NC LWF, NCDOJ EEG, NC DEQ WRDG, NC DEQ DWI, NC	9.6, 10.3

Item	Priority	Action Item	Timeline	Potential Funding Resources	Section Reference
				Sea Grant, NC DEQ	
15	6d	Develop Future Conditions Septic System Viability Master Plan.	Future	NC DEQ 319(h), FEMA BRIC, NC LWF, NCDOJ EEG, NC DEQ WRDG, NC DEQ DWI, NC Sea Grant, NC DEQ	9.6, 10.3

APPENDIX A. DWMP Advisory Committee

DWMP Advisory Committee Meeting Minutes and Presentations:

- Meeting 1 – Advisory Committee Kickoff, March 2021
- Meeting 2 – Community Perspectives, April 2021
- Meeting 3 – Communication and Engagement Plans, May 2021
- Meeting 4 – Survey Questions, June 2021
- Meeting 5 – Data Collection, Draft Mission, Stakeholder Interviews, August 2021
- Meeting 6 – Data Analysis and Management, September 2021
- Meeting 7 – DWMP and SHI Discussion, October 2021
- Meeting 8 – Draft Plan Review, December 2021
- Meeting 9 – Draft Plan Review, January 2022
- Meeting 10 – Draft Plan Review, continued, January 2022
- Meeting 11 – Final Review, February 2022
- Meeting 12 – Final Comments/Revisions, March 2022

Minutes and presentations can be found on the town webpage at:
https://www.nagsheadnc.gov/1035/Decentralized-Wastewater-Management-Plan

APPENDIX B. Public Communication and Stakeholder Engagement

Reports and Studies:

Vorhees, L. and J. Harrison. 2021. Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas: Perspectives from Wastewater Managers. North Carolina Sea Grant UNC-SG-21-06

Harrison, J, O'Driscoll, M., Humphrey, C., Hill, K., White, H., Shephard, K., and J. Bowden. 2021. Wastewater Infrastructure Tipping Point: Climate Adaptation for Onsite Septic Systems. Carolinas Climate Resilience Conference.

O'Driscoll, M., Harrison, J., and K. Hill. 2020. Climate Change Influence on Coastal Onsite Wastewater Infrastructure. NC Climate Office: Climate Change Webinar Series – Sea Level Rise.

Harrison, J., O'Driscoll, M., Edwards, E., Dubbs, L., and L. Cahoon. 2020. Wastewater Treatment along North Carolina's Changing Coastlines. NCWRRI Annual Conference.

June 2021 "Tipping Points Project: Septic Climate Interviews, NC Sea Grant- NC and SC interviews with 20 septic installers and 8 health regulators" Dr. Jane Harrison NCSU

Fall 2020 "What Lies Beneath: Septic Systems and Water Quality in Nags Head, NC" UNC Capstone Report (3rd Year of Study)

Fall 2019 "People, Water and Septic: A Coastal Case Study" UNC Capstone Report (2nd Year of Study)

Fall 2018 "Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity" UNC Capstone Report (1st Year of Study)

Perceptions Report and Study Summary

Town of Nags Head
Decentralized Wastewater
Community Perspectives Memo

Below is a review of existing studies in Nags Head and resulting community perceptions.

1. 2/2020 Coastal Hazards Infrastructure Vulnerability Assessment Duck NC – Western Carolina University – The study did not include any community input. They looked at the vulnerability of their roads and buildings and ranked them by their exposure vulnerability. Most of the higher risk exposures in the town of Duck occur on the western sound side where they are vulnerable to flooding. The conclusions were that most of the town is at a higher elevation and has relatively low overall vulnerability, although there are several buildings in their commercial area in areas of concern.

2. Fall 2020 "What Lies Beneath: Septic Systems and Water Quality in Nags Head, NC" UNC Capstone Report (3rd Year of Study) *(NOTE: There is a lot of good scientific data and analysis as well as the community perspectives part of the report. These studies are focused on the Gallery Row Subwatershed area of town)*

   "There were several takeaways from the human dimensions aspect of this study. Survey respondents indicated high risk perceptions regarding septic systems, which correlates with the findings that groundwater contamination from septic systems is a problem in Nags Head. However, there are variations in knowledge regarding septic information among survey respondents. Those who claimed to be knowledgeable were more likely to have their tanks pumped regularly, indicating that engaging and educating property owners about septic maintenance could encourage positive behavior in the future. Most respondents believe the Town of Nags Head has a responsibility to provide information on septic systems. If the town would like to increase outreach and property owners' access to information, survey respondents expressed they would prefer to receive information in the form of electronic newsletters from the Town, the Town of Nags Head website, the Dare County Health Department website, and videos/webinars produced by the Town of Nags Head."

3. Fall 2019 "People, Water and Septic: A Coastal Case Study" UNC Capstone Report (2nd Year of Study)

   "When gauging risk perceptions, we found that in line with our hypothesis, three stakeholder groups (public officials, researchers, and septic professionals) perceive a high risk of contamination of groundwater from poorly maintained septic systems. Property owners, however, perceive a risk of the sound and the ocean being contaminated, and did not typically address septic interactions. More awareness of groundwater-wastewater-surface water contamination could be raised through outreach and would likely be successful in mitigating the issue because of people's deep connections to this area and their awareness of many environmental changes that are already occurring, making them more motivated to change personal behaviors. Because of the limitations of this study, more research into the interactions between wastewater, groundwater, and surface water in Nags Head is warranted. There are many improvements to data collection that could be made to the study in the next year to increase the accuracy and connectivity of the study's conclusions. For bacterial analyses, sampling the same wells for water quality, identifying additional indicators of bacterial origin in wastewater, and looking at water use records will help explore connections between localized and seasonal water use and groundwater-wastewater-surface water interactions. Mining for data on septic system age, type, and inspection history will improve our understanding of the relationship between septic systems and their effects on the hydrologic cycle. Next year's study could further explore the hydrosocial cycle through a sociological lens by looking into how the considerably larger seasonal population of Nags Head can be educated about groundwater-wastewater-surface water interactions. The findings of our study indicate that Nags Head would benefit from more action by both individuals and decision makers for the Town to ameliorate issues arising from groundwater-

wastewater-surface water interactions. More research into these interactions is warranted so that the temporal and spatial limitations of our study can be minimized. Our study helped to demonstrate the risk of these interactions through GIS analysis to determine if the Town's recent actions, including the Todd D. Krafft Septic Health Initiative and the recent groundwater table lowering, have been successful. Our findings indicate that the groundwater lowering may have been successful in improving water quality in the at-risk areas, but more research and connectivity is needed to strengthen these conclusions. More outreach and education for the general public and seasonal residents of the town is warranted in order to increase the general knowledge level of the public's perception on wastewater risk. The three-episode podcast Flushed: A Potty Talk Podcast, which was produced concurrently with this report and uses the study's findings, would be an effective tool to use in this outreach."

4. Fall 2018 "Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity" UNC Capstone Report (1st Year of Study)

   "Conclusions and Implications: The home-and business-owners in and around the Gallery Row sub-watershed that we interviewed value Nags Head and the Outer Banks for a variety of reasons. A combination of connections to water, community, and resiliency revealed a strong sense of place among participants. These attachments to place and water and associated knowledge and experience positioned our participants to make observations of the community's vulnerabilities to environmental stressors. Participants cited increased storms, flooding, and climate change as drivers of concerning changes to water quality and quantity. These concerns translated into perceptions of risk of septic leachate, septic tank failure, and ultimately worsening of water quality. Although participants acknowledge these issues with current wastewater treatment systems, they expressed hesitation over centralized wastewater treatment citing costs, feasibility, lack of knowledge, and density development as barriers to change. Noting the tradeoffs between treatment methods and fear of large-scale change, the negatives associated with centralized treatment outweighed the current risks associated with septic systems for our participants. Addressing the perceived risks was thought to be the responsibility of the Town of Nags Head even though participants did note how they as individuals may improve their own wastewater treatment systems. These findings improve our understanding of how participants' value water quality, responsibility, and adaptation in Nags Head. These perceptions may impact future decision-making in Nags Head regarding wastewater treatment and environmental management policies."

   Conclusions on perceptions: "Analysis of our semi-structured interviews revealed that participants are attached to the waters of Nags Head for a myriad of reasons including aesthetic value and uniqueness, as well as for tangible benefits like recreation. Many of them believed that not only were the waters and other environmental conditions changing, but the changes were also being exacerbated by a combination of poorly managed stormwater and tourist-driven economic development that is resulting in increased flooding and decreased water quality. While many participants mentioned a broad variety of flood mitigation methods, they expressed a shared sentiment that there 'was only so much that one can do' to mitigate flooding. They lacked a reliable source of information about septic system maintenance, methods of wastewater treatment beyond septic, and quantitative measures of water quality. In general, septic systems as a wastewater treatment method were preferred over centralized sewage for a number of reasons including concerns about the expense and feasibility of installation and maintenance.

   After analyzing our interviews, it seems that the citizens of Nags Head could benefit greatly from a central repository of information on wastewater treatment, flooding incidence and water quality that could better prepare the public for future flooding events and increasing climatic variability. A lot of participants acknowledged that they were in Nags Head because of the water, but on the other hand were reluctant to spend money on fixing the problems of flooding and water quality. Existing efforts like the Septic Health Initiative currently managed by the Town of Nags Head are a step in the right direction, but they do not seem to be effectively communicating that flooding and water quality problems are ones that the townspeople are going to have to make decisions about very soon and that the decisions will not be without cost."

5. 2013 Nags Head Acres Evaluations and suggestions about stormwater and septic tank management among residents of Nags Head Acres – East Carolina University – This study was all about resident and town staff perceptions, led by anthropologists. They met with 1/3 of the residents and included scientific information, especially related to groundwater tables. The main concerns included several items related to standing surface water, but they do wonder about the relationship between groundwater/surface water and septic tanks. A majority of residents reported no problems with their existing septic systems, but about 70% wished for central sewers although they thought it unaffordable to construct and maintain. They recommended continuing the current SHI program.

6. 6/2006 An Assessment of Outer Banks Coastal Environmental Conditions LID implementation considerations. No direct public input into this study, but here are some key points:
   a. Page 26 Table 4 shows the Power/Authority which may be designated to specific organizations for who can assess fees, taxes, etc.
   b. It mentions needing public education workshops and pilot projects and mentions UNC-CSI and SWCD help.
   c. Mechanism for Implementations: Regulatory enforcement (including sw inspections), voluntary programs, and incentives programs
   d. Appendix B summarizes the existing sw regulations by town
   e. Appendix C includes a model sw ordinance

7. 2021 (Finalizing June) Tipping Points Project: Septic Climate Interviews, NC Sea Grant- NC and SC interviews with 20 septic installers and 8 health regulators
   a. Regulators evaluate a snapshot,
      i. Inspections require upon installation and if there is a problem and needs to be investigated for conventional systems
      ii. Engineered systems require regular inspections
   b. Communication with homeowners is limited and inconsistent. Information communicated upon installation and after that varies.
   c. Information not provided directly to homeowners. Usually found on a website for maintenance and post flooding
   d. Some realtors and local health departments provide.
   e. 12% said systems will fail if dry soil and heavy rain
   f. 58% said systems will fail if wet soils and heavy rain
   g. 76% said systems will fail if both wet soils and king tide
   h. Positive drainage biggest positive for long term septic functionality, followed by soil type and elevation.
   i. Installers are seeing 65% of homeowners installing adaptive measures.

Stakeholder Interview Summary and Key Takeaways

Town of Nags Head

Decentralized Wastewater Management Plan (DWMP) Update

Stakeholder Interviews Summary and Key Takeaways

August 2021

1. Giveaways
    a. Leaky toilets can easily cause failures. Consider a toilet flapper giveaway and possible rebate/credit
    b. Window clings on what not to put in the toilet for rentals
    c. Additional ideas: Grease can lids, shower/toothbrush timer

2. Green Business Initiative
    a. Incentives and shades of green based on level, for example:
        i. Level 1: eco conscious
        ii. Level 2: eco friendly
        iii. Level 3: eco warrior
    b. Annual water droplet award/eco-tourism/friendly business

3. Generally, no support for centralized WW/sewer. This can create increased development with smaller lot sizes and lose the Town's character, buffers, and setbacks of Nags Head.

4. Older systems sited too close to water table. Water table has risen. Higher water table don't necessarily cause it to fail. Hydraulics push the water out of the tank into the drain field due to house elevation. Treatment coming out isn't being treated effectively. Nutrients and bacteria aren't filtering through due to lack of cover (18"). Tipping point is when it's backing up into the house and/or the back yard is turning into a septic puddle.

5. Rentals
    a. Many rentals are overbooked with large groups, aka: "more heads in beds." Septic systems aren't designed based on rental occupancy but rather on number of bedrooms.
    b. Systems are designed for number of bedrooms not occupancy. This could be a revision within building code standard through the Town.
    c. Advertise for sale homes based on number of bedrooms, permitting for bedrooms only, and rented for number of bedrooms vs. occupancy. *Example: Consider increased regs for rentals with over occupancy (annual inspection, pump, and bigger/advanced system)*
    d. Bigger houses are using/installing advanced pretreatment with smaller drain fields.
    e. Talk to homeowner that the system is designed for so many people. Something in rental contract. Peat system/equalization system has issues with over occupancy. Occupancy

design is tricky but may be able to add under the building code. 4 bed that sleeps 10 or 12. Large systems won't work based on the size of the lot. Advanced system would be more likely but would cost too much and would not be able to see a return on investment.

f. Note: possible grant program for retrofits/repairs based on need (income) and location.

6. Grey water individual reuse would be a good idea or irrigation.
    a. Follow up: Look into cost of full grey water reuse/recycling vs. cost of septic and savings on water bill.
    b. Advanced treatment or drip distribution would help with pretreatment
    c. Decentralized WWTP that cleans septic and then recirculates it back to the homeowner's tank and drain field would be a good way to remove pollutants. Easement needed on plat. The process would keep existing onsite infrastructure and return as grey water for reuse, irrigation, or groundwater recharge.

7. Future:
    a. Decentralized cluster systems may be needed for failing septic systems due to high groundwater tables. S. Nags Head and sound side have higher groundwater tables than ocean side.
    b. Raised beds are another option but can compound stormwater and flooding issues on neighboring properties that don't have a raised bed.
    c. Advanced pre-treatment and advanced systems are expensive but may be needed in areas that are challenging or have limited area for a repair field
    d. Decentralized WWTP that cleans septic and then recirculates it back to the homeowner's tank and drain field would be a good way to remove pollutants. Easement needed on plat. The process would keep existing onsite infrastructure and return as grey water for reuse, irrigation, or groundwater recharge. Old Nags Head Cove would be a good location for this due to the canals
    e. Package plants or central sewer are last resort
        i. Central sewer in KDH costs about $300,000 annually to operate. Does not include upgrades or other improvements.
        ii. Large spray or pond needed for disposal

8. Hard to locate tank, what type of system do they have
    a. Septic Plant list
    b. no parking
    c. records from Dare County are paper. Requests are last on the list of to do's and sometimes can take longer to process.

9. Advanced systems (EZ Tank) prices are $40,000+. What is the incentive to install these and are there barrier based on price or permitting for rehabs and year-round residents?

10. Education and Outreach
    - Approach to education:
        - Out of sight out of mind. Provide plat map, easement or better marking or online location GIS map. Currently Dare County does not have an online database for septic system permits or plats/location of systems.
        - Differentiate between inspection outreach (fall/winter) and pumping outreach (winter/spring)
        - Different timing on flyer mailings than currently using
        - Planting setback
        - Rope off drain field
    - More educational materials – Dare County to give out flyer, mailer, advertisement

- Work with septic inspectors and property managers on outreach to hone the messaging
- Focus on education for hotspots or failing areas based on data
- Develop education for engineers
- Water Quality Fair
  - Septic inspectors
  - Vendors
  - Model of septic tank
  - Stormwater
  - LID
  - Soil and Water
- STEM Outreach Kit – water quality testing via citizen science using LaMotte kits or similar
- Coordinate with Jenette's Pier to develop water quality education at Pier
- Coordinate with ECU CSI to hit on water quality and develop curriculum for tour operators on water quality
- Engage other groups interested in water quality
  - Surfrider
  - NEST
  - Duck hunting- Ducks Unlimited
  - Jockey's Ridge
  - Cape Hatteras
  - Fishing Community
- Oregon Inlet- redevelopment occurring near Oregon inlet
  - Small museum
  - Provide education
  - Russell King

11. Commercial Business
    - Educate on how to read septic analysis report- Town provide technical assistance to business owners to interpret reports
    - Seminar for business owners
    - Award Program- Water Quality Warrior- Green Business Initiative
      - Recognition for business owners for voluntarily participating in program like septic inspection; pumping; paper bags; lighting; electric vehicle charging stations; wind turbines, etc.
    - Restaurant waste is hardest to treat – FOG (fat oil grease). Septic pretreatment needed for restaurants

12. Residential Additions
    - Voluntary Septic Service Subscription
      - Residents pay for the Town to coordinate inspection, pumping, etc.
    - Grant program
    - Increased loan amounts

13. Stormwater
    a. Single-family rain gardens
    b. Green Stormwater Infrastructure to help filter pollutants prior to entering outfall or sound/estuary
    c. Nature Based Solutions
    d. Increase groundwater infiltration/aquifer recharge

e. Higher groundwater during rainy season, stormwater management is good at containing/managing stormwater, groundwater lowering projects. Nags Head is ahead of the game compared to others in Dare County.

14. Program Support
    a. Overall program is well supported
    b. Dare County specifically wished others would follow Nags Head lead in being proactive
    c. Working class needs the program

Stakeholder Interview Responses

Town of Nags Head

Decentralized Wastewater Management Plan (DWMP) Update

Stakeholder Interview Notes

Wednesday, August 18, 2021

Real Estate Agent

- Haven't seen any report on what is changing with the program
- **Perception of the program**
  - System is a good system
  - Need to understand how many people using septic and don't think our program is adequate to serve need
  - Nobody wants to talk about commercialization of the beach
  - Difference between what we're adding in the ground and groundwater rise
  - Sizing system for usage that happening, i.e.: 8 bedrooms for 20 people
  - People staying beyond capacity, consider occupancy limits based on septic size?
  - All comes down to the dollar
  - Stop building such big houses; better manage rentals- marketing of smaller homes
  - The smaller the house- still can make good money
- **Permitting**
  - Don't know if we can regulate much more based on current regs
  - Goes back to dollar on rentals- more affordable for guests
  - Septic systems are being overtaxed because of over capacity
  - Where is the groundwater table?
  - Grey water reuse-
    - Took grey water and ran those through the toilet- could cut back 2/3 water going into leech field
    - Don't want big mass and density and building or central sewer
    - If you do central sewers it will allow more density
  - Rent small house on oceanfront- stay at multiple different houses close by
  - Town certificate occupancy
  - Black water vs grey water – different treatment types, drip irrigation and/or advanced treatment
  - Question: Do you see role for cluster systems?
    - That might help- hurdle- how we regulate for zoning because changed septic capacity- argument might be that you can add more density
    - KDH example- 8, 5 bed houses- let's put as many houses as we can put on it.

        - Village- can add more lot coverage- central sewer
        - There is a place for it
        - Year-round rentals- how to accommodate year-round rentals that are affordable
        - When you open to cluster housing situation, then it puts a lot of pressure on zoning
        - Balance tourism, economy, lot size, and development
    - Dare County Environmental Health- provide permit for septic- add fill for separation and roll on
- What do future conditions look like with septic?
    - South Nags Head has high groundwater and will fail at any given time. More people in houses during fall/winter holidays.
    - Who knows what time frame is?
    - At some point, we won't have sewer
    - Got to be balance
    - Use groundwater for drinking
    - S. Nags Head area is urgent
    - Decentralized cluster systems due to high groundwater table as alternate in future or WWTP. Negatives:
        - Developers will argue that they can put twice as many houses on the site
        - Will change character of Nags Head
        - Zero lot lines
        - Townhouses, duplexes
        - Increased impervious surface
        - Rental for lower income/workforce/residents
        - Zoning in UDO would need to be regulated more
- Other challenges related to wastewater
    - Old Nag Heads Place- septic is inspected in areas where there are trees to check systems before they sell.
    - Septic vs sewer- people generally don't have a problem
    - Is there any education for homeowners?
        - That is happening from some perspective
        - Give general education on basics and maintenance when people buy
    - Some old bottomless
    - More education from property management companies
    - NC real estate association
    - Videos-
        - How does it work
        - How to maintain
        - Don't play in the water (Mercer infections)
        - Rubber Duck standing water
        - Positive spin
- Inspections- town may not have capacity to inspect as frequently as needed
    - Benefit of town, not motivated to sell you something, trusted
    - Have to charge and increase staff
    - More education of real estate and home inspectors on septic inspections. Only 4 companies inspecting septic at point of sale in area.
- Septic inspection, rebate, and loan program-
    - Do you think this is a free program or should we be charging?
        - Free inspection is good
        - People don't take advantage of loans
    - Rebate- credit- good
    - More publication of existing incentives-

        - Social media post
        - Mailing – quarterly, more calls
        - Go through OBX association of realtors
            - Have flyers at OBX association
            - Spot on owners' page
            - Give link to OBX association of realtors
- More education for realtors-
    - Real estate commission- any education would help
    - Could make septic a larger part of continuing education for annual recert.
    - 1,200 part time agents- not believers in education (sell 1-2 houses a year)
    - 1,600 full time associates
- NFIP CRS points for watershed education
- EPA- Septic Health Week- Sept. 20-24, 2021
    - Septic Smart Week
    - Enviro-scape model

Septic Inspectors

- Septic Health Program is good
- Schedule more inspections in winter
    - June- August is worst time to do it. Hot for inspectors, takes longer, people in rental houses
    - Inspect tank- winter to early spring – push after Labor Day to inspect
        - People put too many people in the house
    - Pump tank- maintenance- spring before season starts
    - Suggested fall/winter inspection, spring pump out (March, April, May)
    - No rest- no downtime
    - Tanks that are unfindable-
        - Some tanks hard to find because they don't want to destroy dune or bushes or etc. to inspect or pump
        - Sand covered access ports by 4-6 feet. Challenging to keep up with changing conditions
        - Relocate tanks/lines that are obstructed
        - Locate tanks and lines
            - Future possibility of coordinating with Dare County Environmental Health for septic tank and line locations
            - Maybe follow up by staff- to clarify maintenance needs
        - Risers were installed- lid within 6" of grade
- What are citizen perceptions of programs are? Do they take full advantage?
    - Reluctant- Don't want government person on property or force them to do something if something is found
    - Some people don't know they have a septic system
    - Pump all the time, never pump, worried about $300 cost/budget = more education
    - Two kinds of people-
        - People who are scared their tanks will blow up
        - And those who say my granddaddy didn't pump for 20 years
    - Need to education
        - Don't sink, don't flush- EPA
        - Flushing coffee down drain; grease; use garbage disposal; wipes, feminine products, contraceptives

        - Just because it goes down pipe doesn't mean it goes away
- What kinds of problems-
    - Wipes, condoms, sanitary products; bathing suits, beach balls
    - Septic systems have filters- since 1999. Many people don't clean these annually
- By having inspection save a pumping, water backing up; water damage in home
- How often do people pump?
    - Rental house- normal system 4-6 bed, pump every 2/3-5 years
    - Rental 6+ beds, pump every year
    - Typical SF- 2–5-year cycle
    - Rental year- at least every 3 years
    - Bigger home - inspect and pump more frequently based on usage
    - Occupancy a problem
    - Pumping for maintenance and pumping for emergency due to overuse
    - Inspection annually
    - Pumping septic is like changing your car oil –
        - Not really wasting money, if you wait too long then could have major problems
        - Difference between inspection and maintenance with outreach- market differently
        - $300 for a pump out vs. $7500+ for a replacement/repair
    - Larger homes get abused more often, typically on the oceanfront and between highways
- Reuse-
    - How do you define grey water?
    - Complicated treatment like systems on the OBX already-
    - Would have to have operator- couple hundred ($100-$200) a year to maintain
    - Regulations are stopping/limiting reuse
    - Larger grey water use for Town of Nags Head?
        - Expensive to retrofit
        - Likely 80% grey water
        - Piping
        - Community sewer plant to water golf course? What to do with the water
        - Manage and plumb and send it somewhere.
        - Have a lot of water to get rid of. Where to send? 4 am when no one is around. Ex- FL- water bushes
        - Retrofitting would be very expensive
        - Class in Nags Head in the past- 50-70% reduction in water reuse in hotels- Battery Park, New York; LID green building/roof top gardens
        - Treated grey water- irrigate.
        - Catch 22- big pipe of grey water might not be answer; if you do that might as well do central sewer
- Conservation
    - Low flow toilet- useless. People just flush more.
    - Low flow fixtures- pressure isn't desirable
    - Would have to have incentives- a burden to use
    - Use outdoor shower and doesn't go into septic
    - Graphics for flyer- a dripping facet adds x many gallons that have result x $.
        - Fixing a leaky toilet can save $20 on your water bill – up to 100 gallons in an hour
        - Add chart of savings
- Most common problems
    - Hung up toilets- educated on monthly water bills- detecting high water usage

        - Monitor water bills
    - Check with property management company- inspect for leaky toilets/facets
    - Giveaway idea – Toilet Flappers for rental homes
    - Plumbing Inspector- YouTube Video on how to replace flapper value $10 part
- Take our abundance of water for granted
- Future conditions- seeing rising groundwater
    - Future of septic systems-basis toward septic systems
    - Amount of fresh water that is available- need septic to replenish freshwater aquifer
    - What is normal intake and output? Water budget for house?
    - Seeing it now- if a drain field needs 12-18 inches of separation and fill mounds- then see taller septic systems
        - Build mid to above ground
        - Either code change or groundwater
        - Open land is no longer open- cause increased
        - Filling for septic- have setbacks
    - Gravity system needs 18” of separation; pre-treatment- less separation- spending more money to do that- require operators and sampling- mini sewer plant in each yard; might get 1-2 that do this - now it is a normal system because lot is smaller, or you want to build a bigger house
    - Commercial systems only need 6” of cover with advanced treatment and can cost between $20,000 to over $50,000 to install.
        - Last 20 years this has skyrocketed
        - Operation and maintenance are a big part of this.
        - Technologies has made this better
        - Peat used to be best- now haven’t seen peat system in several years. EZTreat are more common.
        - Can spend more money, just few thousand for better treatment and maintenance
            - Approx. $1,000/year
        - Installers are good at keeping up with new technologies
            - Have good mutual relationships
            - They work together
            - 30 of 40 installers- 75% can or will do newer technologies
        - Engineers are up to do date on that too- they design and recommend- they are driving force
            - Education for engineers
        - Are people switching to newer systems?
            - Most people will try to put in conventional if possible
            - Having larger septic system will allow more bedrooms and if they do that then can add more density
    - 12-bedroom house is no longer a conventional system
- Take away
    - Work with inspectors to develop outreach based on what they are seeing
- Problem-
    - If they are used as they are designed- then ok
    - If abused, then a problem
    - Driving factor is economics
    - 1,800-gallon tank min if an do a larger amount for a little more than they will
        - What’s the tipping point?

- Effluent filters based on usage-
    - If abusing system- oil based products, milk- educate what are oil based- coffee, milk, spaghetti.
- Drip irrigation- is its own nightmare- they can go unworking really quickly
    - More time to drip
- Need to upgrade plumbing fixtures and old plumbing
    - At a minimum toilet flappers
    - Leaky toilets add are more volume than fixtures (sink or shower leaks)
    - More volume of water than retrofit
- Incentives?
    - Higher credit
    - Don't understand what to do after inspection
    - Call local pumpers – decreased rate, example 10% less for Nags Head customers
    - $10 credit for flapper
- Education-
    - No Grease and non-bio-degradable items
        - Candy wrappers- don't sink it; don't flush
    - location and how it works
        - don't understand the basic parts
        - what the tanks do
        - post and rope drain field
    - Educational magnet
    - What's that smell?

Local Business Owner

1. Been here since the 70's
2. Now other problems, so much that quality tourism has brought us; Best school
3. Beach nourishment is so important; important to maintaining quality designations
2. Commercial system on the causeway- high tech EZ Treat
3. Houses- basic gravity systems
4. Didn't know about inspections
5. Have used the pump outs credit in the past- seems like the credit was larger in the past
6. Education-
    - Cost of fixing septic has more than doubled
    - People would become more engaged
7. Help you or others to push out message
    - Flyer – postcard mailer
    - Meeting with vendors might be helpful and what services are available
        - Water quality fair at Dowdy Park
        - List of vendors that are in the area-
            - Inspectors
            - Pumpers
        - Many new homeowners; don't see it; come from VA where there are central systems
8. From your perspective- why does water quality matter
    - Matters because-
        - Along ocean and the word to get out- it would impact tourism and were known for clean beaches

- Impact tourism in a negative way and hurt the economy for the whole region
- From water sports- surfing, kite boarding, jet skis, kayaking
- Still family destinations and concerned about children's health- if they think ocean and sound is detrimental to health then won't take them into it.
- Need to maintain that
- To keep Nags Head clean and beautiful- do your part …
- Our business would be directly impacted
- Potential for broad impact as a region, all businesses, taxes, trickledown effect.

9. When it comes it testing, what type of information would be helpful? Do you want to know or understand water conditions?
    - Yes, comparisons
    - They want to know if it's **safe** and any **trends** and what do they mean and how we **compare** to other similar coastal communities
    - Celebrate where we are! So, they take pride in good water quality
    - Clean beaches and good water quality

10. STEM Education kit
    - Coordinate with the pier
    - Retired homeowners

11. Site on the causeway- environmental signage on decks-
    - Coordinate water quality sampling demonstrations with education tours like dolphin tours
    - Coordinate with CSI to hit on water quality and develop curriculum for tour operators on water quality.

12. Recreational groups to engage to promote and support good water?
    - Surfrider – beach cleanups
    - NEST
    - Duck hunting- Ducks Unlimited
    - Fishing-
    - Oregon Inlet- redevelop Oregon inlet
        - Small museum coming
        - Provide education

13. Future conditions
    - Rising groundwater tables
    - How will that affect Nags Head?
    - Difficult for systems to work
    - State rule- couldn't put in fill for septic- don't understand
    - Cottage court approach appeals to me- centralized a small high-tech system and serve several houses
    - Figuring out a solution to have solutions to keep houses habitable

14. Difference between groundwater and surface water

15. Communication is key. Needs to be addressed somehow

16. Pinpoint an area –

- Goose problems cause water quality concerns

17. Need to figure out how to maintain water quality to maintain way of life

18. Do you think commercial businesses would benefit?

    - Yes, I would think so
    - Commercially, inspected per quarter and once a year
    - Don't understand reports-
        - Educate on how to read report- Town provide technical assistance to business owners to interpret reports
            - Seminar for business owners – system types, how they work, what to do if there is a problem, maintenance
        - Award Program- Water Quality Warrior- Green Business- Eco-Tourism
            - Recognition for business owners for voluntarily participating in program like septic inspection; pumping; paper bags; lighting; ev

Local Business Owner

- Big proponent of plan
- Does not favor centralized wastewater
- Enhance Septic Health:
    - People not aware
    - Not a stick, only help
    - Encourage participation
    - Can't waive taxes or water fee
    - Increase water bill rebate for pump out from $45 to 50% of bill w/in 60 days. Potential federal grant for assistance
    - Social media for education
    - NC Coastal Federation/NC Sea Grant
- Peat Systems are failing (alarms always going off) at Sugar Creek Condos
- Estuarine Shoreline an issue – evolve, different by using raised beds and pump tanks
- More flooding on soundside after a hurricane or nor'easter
- Education:
    - Help people understand the type of system
    - Out of town aren't as involved – more education or different approach
    - Email blasts
    - YouTube videos
    - HOA education – west side (not including the Village): North Ridge, S. Nags Head, S. Creek Acres
    - Village Realty
    - Social Media, Next Door Posts
    - Survey the right people (septic vs. central/individual permits)
- Other communities are doing septic or may not be interested;
    - Kill Devil Hills is on central sewer
    - Manteo is on sewer/WWTP
- Water Quality:
    - Don't want ocean/beach closures
    - Recreation is key to connect septic to WQ

    - Increase buffers. Variances to buffer rules and stormwater regs
    - Add a rain garden to homes
    - Green Stormwater Infrastructure – make it easier with less barriers
- Voluntary Utility:
    - Interested with a possible $50 membership fee/dues
- Visuals are always good to help with the messaging
- Show data, details, and proof of what is happening

Property Managers

- Managers remember when program started; haven't read about it lately; avoid septic systems impacting water quality; help to avoid overflow from getting to water
- Familiar with septic health initiative
- Think it's a good idea; haven't heard about it since the beginning; require information about septic; monitor how often they pump; every other year smaller homes, larger homes- every year; engineered systems- every year
- Had personally used program (inspection and pumpx2)
- Others haven't utilized program
- Relationship between property managers and property owners
    - Get people to pump on a case-by-case basis; same as DH recommend don't require
    - Each January- request for service form- can request a septic inspection; can arrange through septic vendor; recommend pumping 3-5 years
    - Evolve- require septic inspection/pumping each year large, small every other year. Vendors identified within contract
- Barriers to getting people inspected or pumped- not really; out of sight; out of mind; waiting for the problem to occur until it's a need
    - Some people wanted to get it pumped twice because of increased rentals
    - Can't find system
    - Problem- filter got clogged
    - Don't want to spend money – free inspection would help drive action if needed
- Problems
    - Clogged filter
    - Sand build-up
    - Can't find system
    - More septic pumps this year with more rain
    - Old construction- everything is failing
    - How do we make people aware of these maintenance problems? Need to do a better job of education?
- How can we promote that? How can we get people to buy in?
    - Spring services form - add Town of Nags Head
    - Educating homeowners and vacationers
        - Annual form
        - Newsletter
        - Homeowners' manual
        - Guests-don't want magnets
            - Have been using clings
        - Pre-arrival info (non-floatable not flushable)
- How do we connect with property owners? What's the best way?
    - Send information to property managers

    - Monthly newsletter only has a 38% open/read rate
    - OBAR has property managers group
        - Property Managers Association- Willow Kelly
- Opportunity to educate owners in person
    - Season is different now
    - Something on their own time.
    - Gov't access channel- Current TV
    - Town/YouTube tutorial/video link sent out via property managers to owners
    - Destination Dare
- Records of people who have pumped but not gotten water credit
- connect with pumpers
- Everyone has gotten more environmentally conscious and caring to sustainability
- Do you think people care about water quality? Do they connect maintenance of systems to water quality?
    - Not sure. When it happens in the past with flooding, they think about it, but not really.
- EPA property flyer- kitchen postcard; bathroom placard – they would love to review and incorporate into messaging
- Inspectors- leaky toilets and facets
    - Get reports from guests- especially a running commode. Very aware of the leaky problem if they know
    - educate visitors- we're on septic; trash pickup; people aren't paying attention- Guests have responsibilities even though they don't think they do;
        - If you love the OBX then help us keep Nags Head clean-
            - Ambassador program-

Designer

- Made commitment to decentralized wastewater; partly a development control
- Help us to maintain low density character
- We have to help people maintain systems and educate them
- How well do you think its functioning?
    - Don't know numbers- include in directors report and yearly report
    - Not sure how readily available to avg homeowner
    - May not understand you have to maintain a system; how do you introduce people to that idea?
    - Basic message- you have a septic system and the Town can help you keep it working
    - How do you help people without them taking it a negative?
- Incentives?
    - Is what we're doing enough? $45 rebate?
        - Should just be a thing you do regardless
        - Get X% back through the Town's rebate program
        - More benefit than incentive
        - Rename to "Septic Pumping Rebate Program"
    - Have people register annually- volunteer info- email to the Town.
        - Make process easy, simple, and not bothersome
    - May have subscription program
    - Voluntary Septic Utility-
    - Perk Program
    - Don't make it cumbersome- easy registration

- Problem-
    - Filter gets clogged
    - Video on cleaning out filter
- As a designer is there anything we can do upfront to help in the long term- not really, do more commercial?
- Better communication pieces critical
- Large homes over occupancy-
    - How should we handle that? If the Town should that?
    - I don't know- reluctant, Dare Co. Environmental Health should be managing
    - Affects neighbors more than property owner
    - Need a protocol- and work to help solve problem
- How do you perceive communication between Dare Co. Environmental Health and Town- strong
- Sea level rise is affecting both stormwater and wastewater
    - Will become issue that we can't manage
    - Then what happens
    - Is there renewed pressure to installed sewer
    - Install groundwater lowering
- Greywater
    - Can you reduce regular septic system by having grey water system?
    - Would it cost benefit ratio- need to see numbers- would it improve the treatment of wastewater
    - Advanced systems that treat ahead of time
- Green Business Initiative: Greening Churches- Methodist Churches; Green church initiative; green business
- What is the hospital doing? What is food lion doing? Commercial recycling

Thursday, August 19, 2021

Homebuilders

- What are prime concerns for utilizing septic? Limits?
    - VP- lot coverage constrains; Amphidrome, parking;
        - Can't get conventional in because you don't have room? Limited between parking, septic, drain field, pool; depends on location; bigger houses seem to be harder; Dare County Environmental Health is stricter and has to have 18'' separation; Victor builds mostly year-round- uses Advantex
    - FS- everyone wants to develop the most they can because of the cost of land; where do you fill when large amounts are required and how do you taper fill slopes. More challenging/more creative.
- What types of systems?
    - VP- EZ Treat- $40,0000 for installation
        - Amphidrome- $50,000; only one installer
        - Tried a little of everything
        - Peat was the thing for a while; peat costs have skyrocketed in the last few years
        - People going away from peat
- Challenges of permitting with Dare County Environmental Health-
    - Process: Land disturbance, stormwater, put fill, have Dare County Environmental Health inspect, and have town inspect
    - More considerate of neighbors in regard to stormwater and positive drainage

    - Year-round homes- fitting conventional system in and having 100% repair area; but not using repair area; Dare County Environmental Health not requiring repair areas to move; loosing property
        - Half or more are rentals
        - Renters don't care
        - Houses sit idle for 6 months of year
        - Two markets- rental market and year-round-
            - It factors into affordable housing
            - Can't get permitted for bed systems if above 5 bedrooms
        - Septic is out of site out of mind
    - How to help educate renters-
        - Use resource of Dare County Environmental Health
        - Don't pour grease down and don't put in garbage disposal – grease can lid giveaway?
        - Rental brochure
    - Property management educate visitors
- Generally, try to be more considerate of neighbors
- What are your concerns about building in the future if the costs of septic keep going up or we're forced to changed?
    - Affordability of systems
    - Can't fit in lot; unless you put in a $50,000 system.
    - Need to find some type of pre-treatment for lots to add an accessory dwelling or extra bedroom.
    - Do we have real numbers?
    - Is there value in the program and are people taking advantage of the program if taxpayers are paying for the program?
- types of technologies available that are affordable
- Central sewage- that would be great
- Water quality has changed over the years
- Is central sewage a perfect solution? Probably not
- septic used as a regulatory tool
    - Maybe too late for central sewage
- Don't like the way it is because there is so much crammed on the lot - get more coverage because of sewer.
- Cost to septic
    - Our workforce can't live here, balance affordability
- Escalation costs- have to reprice every 6 months
- Have seen effects of water table rising
    - Maintenance is a good thing
- Look to experts for future solutions
    - Need to be told what will work
- Education to home builders and engineers on types of technology that work in this area
    - Town provide a list and continuing education; work with companies to advocate and bring them to this area
    - Approved list of systems
- Maintenance-
    - Consider maintenance in design and installation?
        - if engineered then yes, they do; if conventional they have to locate and try to install so it is accessible
        - usually 8"-12" of fill on top of tank
        - Riser- safety concerns

        - Take pics of tank and send to the plumber so they know where the tank is upon installation for the homeowner
            - Rope off tank and drain field so people don't park on leech field
        - Does landscaping happen during construction or after?
            - Depends on customer – usually at end of build
            - Pools are governed by building code – 15 feet away from field, decks 5 foot of separation
- Use of program-
    - are people using the program and is there value and is it cost effective
    - People could do it on their own
    - Tenants for responsible to take care of systems
    - Some cases Dare County Environmental Health requires barrier around septic if next to driveway
- see if other communities want to join. We can't save the world. Nags Head can do everything right; and still have problem

Recreational Users

- Kiteboard; Jockey's Ridge; Harvey site; dog owner; child watcher; swim in sound
    -
    - Concerned about sound water quality related to cuts
    - General concern in kite boarding-
    - Like stormwater controls due to health concerns
    - Under impression we have a water quality concern
- been in the water regularly 25 years- paddle boarding, kiteboarding; Jockey's Ridge; Harvey site; closer to Oregon inlet; lots of time in the ocean; a lot of time in the sound
    - Not sure if there is an improvement or gotten worse
    - Have friends who don't want to go in the sound because of water quality
    - Think water quality is poor after rainfall- based on experience, clarity, smell, salinity
    - Absolutely have local problems
    - Harvey Site- mob of people
        - Can smell septic
    - How many people have made use of the program
        - Need to tell the DWMP and SHI story- Make inspections numbers more visible- talk about our successes! Demonstrate the value of the program- what are our metrics of success
    - Direct experience- smell; turbidity; salinity; color; transparency; understanding of connection between water quality and development
- out of site out of mind; recycling is parallel- easy to know what to recycle and not and we have direction
- How can we make it easier for people and reach more people so they can understand?
    - Most people motivated by money- maintenance can save money long term; greater environment; especially the water
    - Educate about what not to put down drain
    - Septic System is bad- something has to be done. Its' not just personal inconvenience, but public health
- Jingle on Rip Currents on Radio-
- You Tube Channel
- Issues coming from houses and septic services; flyers for septic services
    - Publicize list of septic pumping
- Technical assistance- the right way to go about the repairs-
    - Pumping up to the elevated field and pump to secondary tank

    - Bottomless tank before and no drain field
- Way to connect-
    - Partner with Dare County Environmental Health to put a flyer- Are you a Nags Head resident? If so, did you know there is assistance for your septic system repair?
- Likes idea of citizen science monitoring
- How would you recommend sharing water quality data that is meaningful-
    - Don't have strong opinion- keep user friendly- keep it simple
        - This is what makes it a bad water quality day- low salinity
- Targeted education
    - Identify the most vulnerable systems; target approach; friendly welcoming way
    - System age and water table level important (older homes most likely failing)
- Do you wish you had a small offsite neighborhood septic system available-
    - Not taking away from footprint of property
    - Would like to pay for someone else to handle waste
- Not sure what plantings to plant around septic-
    - Create septic planting guide
- Subscription- sign in for managing your system- regular basis inspections or pump outs were made- That's smart- I like that! Someone is paying attention to it and it's not a crisis event- especially absentee owners
- Typical costs of systems in Nags Head - typical costs of maintenance - include in plan
- May not motivate people- green recognition for homes
    - Recognize people or town have a list of where people can see examples on the ground. "Green Initiative Scavenger Hunt" and signage
- Future conditions-
    - As groundwater rises- problem will grow
    - Could be pollical issues
    - Don't create now problems in "fringe" areas
    - Every million-dollar house, tempered not to create problems for tomorrow
    - Soundside- maybe that's better that not happen; not the right thing to do; future buffers or green space
    - Need to consider future development in hot spot areas and make wise decisions-

Environmental Groups: Jockey's Ridge State Park, North Carolina Coastal Federation (NCCF), The Nature Conservancy (TNC), Jennette's Pier

1. What does water quality mean to you/your program?
    - Soundside has water quality issues
    - Groundwater interaction
    - More education needed in community
    - Swimming
    - Lifeline

2. What is everyone doing?
    - Jennette's Pier – stormwater, aquarium backwash, reclaimed water- weekly testing, no water quality programs (yet!)
    - TNC – 2 monitoring wells, ECU CSI, no outreach/education
    - Jockey's Ridge – monitoring wells, soundside monitoring subaquatic vegetation (SAV)
    - NCCF – education for K-12, LID, ordinance development, grant funding 205j, management strategies, reroute outfalls

3. What could be done to better educate? To improve?
    - Post everything
    - Grease down the drain education
    - Rentals – no good method
    - Ocean friendly establishments –Green Business Initiative
        - Jennette's Pier
        - NCCF
        - No plastic bags
        - 5-star rating system
        - Always good actors will continue, What about the bad ones?
        - Discount on water bill
    - Citizen Science
        - Jockey's Ridge does a bird migration program
        - Contact information could be obtained from results
        - YouTube Video
        - Management/Owners/Residents
        - Consistent messaging/branding across region for media campaign
        - Giveaways: grease can lids, water quality kit, toilet flapper
    - Additional discounts
    - Neighborhood level
        - Focus on older homes w/older systems& bottomless tanks
        - Specific areas – soundside

4. Other suggestions/information
    - Rachael Noble Study
    - S. Nags Head WQ Data
    - 3-year pump out ordinance (required)
    - Septic pump cost $300 +/-
    - Septic replacement $7,500 - $40,000

August 27, 2021

Soil Scientist

1. Tell me more about your work and your general understanding of the Town's SHI.
   Been working in the industry for 33 years between Raleigh, NC and coast
   Helped with sampling groundwater wells in Nags Head Woods
   Mostly sandy soils in NH, not a lot of peak/organics or unsuitable soils.
   Doesn't know about the DWMP or SHI

2. How can we reach people more effectively to ensure they maintain their septic systems? What are the barriers?
   Free stuff- free pump, bigger loans, reduced price on advanced systems, reduce barriers for installation.

3. What are some trends you are seeing in septic installation/design – advanced systems, grey water reuse. What are the costs of a traditional system vs. advanced?
   Raised beds/mounding
   Groundwater levels are rising. Bringing in $4,000 to $6,000 worth of sand.

Larger 8 Bedroom houses with elevations at 3' above sea level are using class 2 systems
$10,000 Clear Stream – dual tank +blower. Possible higher electric bills
$40,000 Advantex

Cost hopefully will come down as competition and demand increases
Systems are overworked in summer, then face high GW tables in winter

4. Do you have any challenges working through Dare County Environmental Health for septic permitting? Any suggestions on process or communication?
   None, permits being issues in 30 days or less

5. What other challenges do you think the Town/region will face in the future? How can we be proactive and prepare now based on what we know?
   Lower groundwater/water table and treat water quality in a basin before discharging. Subsidence issue would occur if very large volume is lowered (100,000+ GPM)
   Additional GW well data.

6. What other incentives or suggestions do you have for the DWMP Update and SHI?
   Free tank pump
   Pretreatment
   Education material flyer with schematic and maintenance
   Dollar value of maintenance vs. repair
   Easy, not overly complicated
   Look at NC regulations. They are overly complicated compared to other states.

August 31, 2021

Real Estate Broker

1. What has the real estate market look like?
   Point of sale inspections
   Dare Co. water treatment
   300' in the ground
   Septic contaminating groundwater due to release 4' in ground
2. Septic tanks – against them due to location and size of lots, occupancy, and capacity. Small houses okay, large houses aren't good for septic.
3. Package plant systems – designed for when nothing else works
4. Decentralized conversion patent concept– conversation/issue with over development – doesn't think it's possible. Want to control density while having better treatment. UNC Kegan-Flagler School of Business helped with research. Leave the existing tanks and field, replace tank, treat at plant recirculate back to the tank. Basically sewerage/water is recirculated treated grey water back to the tank/field for infiltration into groundwater table. 1 acre = treatment for $5,000. Easement on field. More details in report…

5. Portion of every lot will be set aside for post treatment. Density controls still in place.

6. What is your general understanding of the Town's DWMP and SHI?
   Out of sight out of mind, people don't care, complaint driven

7. Do you think septic systems are under designed for the occupancy of rental homes?
   Yes

8. Are you seeing more failures due to high groundwater tables? Yes

9. Scale up or down. Treatment to a pond then dispose, UV,
   Old Nags Head Cove – would be a good location
   Central sewer system = same cost as conversion plant
   Subsidized by state grants/funds.

10. KDH system – 600,000 GPD = 2,000 customers. 120 gpd per bedroom. Actual flow is 60% of design flow. A state-of-the-art reclamation re-use quality wastewater treatment plan permitted by the State of North Carolina and regulated by the North Carolina Utilities Commission. The facility serves hundreds of customers including shopping centers, schools, hotels, restaurants, various businesses, multifamily and single-family residences.

11. KDH - Where is the disposal? Spray fields, filtration ponds, irrigate yard/golf course, infiltrate back into the water table. How big is the field – Bermuda Bay 70 acres

12. KDH – connection fee/rate controlled by NC Utilities Commission. Certificate of necessity. 3 bd $5,000 connection/initial fee + $72/quarter.
    WW-Rate-Sheet-21-22 (kdhnc.com)
    Water & Wastewater System Development Fees | Kill Devil Hills, NC! - Official Website (kdhnc.com)

13. Initial and annual maintenance costs?

    $300,000 to operate annually
    $500-600,000 to upgrade to remove nitrogen. Convert ½ plant to anerobic system, other half aerobic.
    20 ppm N limits, Mix the two together to get 10 ppm.
    No grant. UNC School of Business helped with everything, free, economic development. Contact was ….

14. Disposal is the key, collecting and treating is a waste of time/easy.

15. Other uses for greywater? Return to the house for toilet flushing. New houses could plumb it in. Renovation of older homes is cost prohibitive

16. Reuse could be “free” to the customer Currently using potable water from Dare Co.

17. Roof water could also be used as well

18. What was the discussion previously on septic vs. central? How have perspectives changes? Health issues are at the forefront at the discussion. Like to see water testing at tank prior to field.

19. Real estate – education, promotion: most people don’t know there is a septic

September 7, 2021

Dare County Health Department Environmental Health

1. **Are you familiar with/know about the Town's DWMP and SHI?**

   Great experience with loan programs. Give out town staff contact information to help

2. **How do you perceive the Town's DWMP and SHI program? Do you think the program is beneficial to homeowners (both year-round, rentals, and owners)?**

   Working class need this

   Update:

   Wish other towns would follow program

   Well-advertised. Getting out to the public more, inspections and credit. Education.

3. **What are the biggest contributors to failing systems? Do you think that septic failures are due to lack of maintenance and understanding of septic systems? How can we help residents, owners, and visitors easily understand the importance of septic maintenance and the link to improved water quality?**

   Variety of issues –

   #1 roots due to shallow systems, planting near systems

   #2 – overuse 20 people into a 4-bedroom house -

   #3 – lack of maintenance, out of sight out of mind

   #4 -damage – people drive on – regs. Don't allow for parking on systems- recommend fence or barrier. No driveway or parking over septic area.

4. **Walk me through the County's septic permit process.**

   Priority list – failing systems go straight to the top. Same day as it comes in.

   Application from owner/owners' agent with signed docs (installers, real estate agents)

   Process – 1 pager form, new system, old system with addition, repair/replacement, new use, shed, inspection.

   Put into workload – today (failing) and within asap (new or change of use)

   1. Failing
   2. Tank install
   3. Fill inspection

   On average 30-40 repair permits per month. Not sure about Nags Head ones.

5. **What challenges are you/county facing in relation to permitting?**

Overwhelmed by workload

Digital records. $150,000 quote to scan. Dare EH Request@Darenc.com- Information request. Low priority. 1 admin assistant. Hard to get. Lots of request for real estate agents. Advertise for number of bedrooms permitting and rented for number of bedrooms. Complaints go to real estate commission.

6. **What/how does the County currently communicate to the Town (building permitting or septic health) in the way of installations, improvements, and failures? How could the County/Town improve the process, increase communication, and/or provide digital plat maps?**

   Excellent communication with the Town.

   If homeowner is refusing a repair the Town would be notified.

7. **What is the process for handling failing systems? Are there opportunities to increase communication with the Town during this time?**

   Soil scientist – EOP engineered option permit. Lot evaluation. Dare Co records the permit. The EOP issues the permit. Soil Scientist/Engineer reviews and approves additions.

8. **What trends are you seeing in septic system installs? Are people going for more advanced systems?**

   Old tanks (open or solid precast) are being replaced. Most homes are 1980's onward.

   Replacement depends – ocean front 5+ bedrooms – advanced, low pressure pipe system since 2016, none of these systems in fill

   small 3-4 bedrooms = conventional

   Drip systems – small number. Mechanics are not conducive to sandy soils. Valving and component are difficult to maintain with sand – filters clog
   Advanced pre-pretreatment with anerobic prior to drip system.

9. **How do you perceive Advanced Systems like EZTreat, Advantax, and Others? What about grey water reuse?**

   Decentralized Cluster Systems

   Grey – do not permit. State Permit from DWQ.

   Step Systems

   More treatment

   Bigger houses are going to advanced pretreatment with smaller drain fields

10. **What type of changing conditions do you think are impacting the installation and maintenance of wastewater management systems? Are you concerned about higher**

groundwater table elevations, sea level rise, or future conditions affecting septic systems, commercial systems, WWTPs, and water quality?

Higher groundwater during rainy season, stormwater management is good at containing/managing stormwater, groundwater lowering projects. Nags Head is ahead of the game compared to others in Dare County.

11. **What do you think are some solutions to balance economics/tourism with large 8+ bedroom houses (more heads in beds) and septic design? Currently septic systems are designed based on number of bedrooms with closet doors not necessarily occupancy.**

    Talk to homeowner that the system is design for so many people. Something in contract. Peat system/equalization system has issues with over occupancy. Occupancy design is tricky but may be able to add under the building code. 4 bed that sleeps 10 or 12. Large systems won't work based on the size of the lot. Advanced system would be more likely but would cost too much and would not be able to see a return on investment.

12. **We have found that homes primarily on the sound side are having more issues with septic failures as well as south Nags Head. This is likely due to higher groundwater elevations and older homes. What concerns do you have about the long-term viability of septic systems in the OBX/region, and what steps do you think we could take collectively to address those concerns?**

    Older systems sited too close to water table. Water table has risen. Higher water table don't necessarily cause it to fail. Hydraulics push the water out of the tank into the drain field. Treatment coming out isn't being treated effectively. Nutrients and bacteria aren't filtering through due to lack of cover (18").
    What is the tipping point – it's backing up into the house, back yard is turning into a septic puddle. Over occupancy is an issue

13. **Would you recommend any revisions to the SHI- education, giveaways, rebates, voluntary utility, and loans?**
    More educational materials – Dare County to give out flyer, mailer, advertisement
    Loan $7,500 – traditional system cost
    ➔ what about advanced?
    Groundwater table issue, elevated systems, fill, new tank, pump system = more expensive replacement
    State grant program – revolving loan

14. Who governs/oversees Dare County EM? Members?
    Dare Co DHHS Board – health department and social services.
    a. Board of Commission – Ervin Bateman
    b. Engineer – David Ryan
    c. Dentist
    d. Nurse
    e. All professionals

15. Additional recommendations
    a. Restaurant waste is hardest to treat – FOG. Pretreatment for restaurants

September 9, 2021

NC Outer Banks Realtors Association (OBRA)

ORBA includes rental agencies and property managers

1. **How familiar are you with the Town's DWMP and SHI?**
   Aware of existence. Knows background, thus far 3 yes, 1 know of OBRA

2. **What issues are realtors facing when it comes to septic systems?**
   Not a big draw back for homeowners, home owner's aren't asking questions

3. **How have you handled a septic inspection at point of sale?**
   Inspection required

4. **Have you seen homes fail the inspection? Are the failures consistent in older homes or specific locations? What is done to remedy the situation?**
   Not an issue

5. **What about pre-sale prep from existing owners?** No issues.

6. **Is it difficult/challenging or time consuming to obtain records from Dare County?**
   None

7. **When a prospective homeowner/buyer is looking at a home for year-round living or for use as a rental, they likely don't ask about septic maintenance. Do you think a septic maintenance 101 and Town of Nags Head SHI flyer, handout, or welcome packet would assist the education process either during an open house, showing, or during the closing process?**
   Welcome packet would be beneficial

8. **What are the prospective homeowner's perceptions of septic vs. sewer?**
   Not worried

9. **Do new homeowners know where their drain field and septic tank are located?**
   See number 6 above

10. **Are you seeing a majority of newer homes using advanced pre-treatment systems that are more complicated than a traditional system? How is the new owner educated on maintenance?**
    thought it would be good to use advanced systems or incentivize

Maybe, septic and flooding continuing education courses are available currently. In person accessible possibly? NCR and NCLM CE credit
Non CE- credit low-interest

11. **Would a water quality festival, vendor type fair/conference, or booth at the RealtorFest this November be beneficial?**
    Potential booth or class/worksession

12. **What additions would you recommend to the SHI?**
    Increase rebate of pump out
    Increased loans – NC R can assist if there are regulatory hurdles.

    Rental Contract will be beneficial to protect owners and septic systems.

13. **Citizen survey, member comments from OBRA**- folks may be reluctant in soliciting help that would result in other code violations. Insulate homeowners from other violations. Remove barriers. 3rd party inspection vs. town.

14. **What are some other ways or opportunities to work together besides education?** - septic pre-emption language, in the budget out of house appropriation and base budget in bill with trees

15. **What do you think about a septic voluntary subscription? Maybe**

Regulators: NCDHHS, NCDEQ WR Washington Regional office, NCDEQ

1. **Are you familiar with/know about the Town's DWMP and SHI?**

   heard but don't know all

   knows, pine knoll shores looked at program, very impressed. Not a lot of surveillance of conventional systems. Reviews large programs >3,000 gpd and industrial systems. Management is a critical component. Sustainable

   forefront, ahead of the curve.

   Water Quality -ocean outfalls repairs, sewage present during storm events, more frequent storms influencing systems. Long term thought, how to things play with outfalls and interior drainage, ditches and canals to surface water. Not an issue in 2021 recent years past there were water quality advisories being issued daily, with hot spots. Weather patterns increased expos

2. **How do you perceive the Town's DWMP and SHI program? Do you think the program is beneficial to homeowners (both year-round, rentals, and owners)?**

   Model for the area

3. **Community/Regional participation**

Education, communicate, share information with other.

Clean Water State Revolving Fund (SRF) – use to repair systems – talk to Vic D'Amato about grant sources from NCDEQ/others

On hold but moving forward with a pilot program. Non-profit SE Community action project – private wells, USDA extend to septic.

4. **What are the biggest contributors to failing systems? Do you think that septic failures are due to lack of maintenance and understanding of septic systems? How can we help residents, owners, and visitors easily understand the importance of septic maintenance and the link to improved water quality?**

   Two types of failures – residential toilets

   Impact to groundwater – harder sell to managing systems

   Install barriers to water bodies to filter groundwater prior to surface water

   Thin out of the box _APNEP, onsite

5. **New regulations in NC**

   Non-discharge land application systems – minimum septic separation, more challenging. Rules get more stringent, increasing treatment levels. Every 10 years rules are updated

   Onsite – proposed rules since 2014. Letters of objection then and now. Trying to give more and expand, provide more value. Private and Health Dept.

   Reclaimed water, reduce size of initial and repair areas

   Unbiased evaluation of water quality

   Random surveys

   Educational effort to program, benefits, information

   Pushback in repair areas – information to explain impacts to maintain

   Septic system permanent systems

   More use of advanced systems

6. **How do you perceive Advanced Systems like EZTreat, Advantax, and Others? What about grey water reuse?**

   Allows higher density of development, closer separation of groundwater. Associated management systems. Need to maintain. Get rid of BOS and TSS but not N. Don't understand the long-term O&M involved $100's per year. Required to have an operator and catch failures vs conventional systems. Conventional systems are regularly inspected or regulated

   Like reuse

7. **Would you recommend any revisions to the SHI- education, giveaways, rebates, voluntary utility, and loans?**

Nags Head N.OBX sewer pump/haulers- expand partnership, link contractors to town
New residents
Septic pumpers – series of pamphlets, discounted rates
Required management entities- reports, pretreatment sample results, compile and put information into a report, water quality samples, inspection reports (monthly)
Realtors – inspection report could be a large selling point to future homeowner
Hesitant to inspect/call – 3rd party, public private partnership

September 10, 2021

Town Staff

Address water quality in innovative way. Infiltration is key.

Extreme weather and wet weather – rely on conveyance rely on surface water drainage. 50+ years old. Ash Wednesday storm connected. Density and OWPS. Increase groundwater baseflow conditions during events to provide capacity and provide create separation between water table. 3 groundwater lowering projects – 1 lowering ocean outfall 1 foot, very positive impact in upstream system, 2- village near town hall – recapture capacity and French drain system to increase capacity in existing storm drain network. Addresses peak attenuation 3 – groundwater pump system in westside neighborhood (2nd) to address flooding concerns. Benefits aid in flood control and disconnect neighborhood from ocean outfall systems. Minimize flood control downstream as increase water quality benefits.
Reclaim ROW -install infiltration swales

Challenges- groundwater lowering going to an infiltration basin, spatial needs. Elevation level of ammonia Nitrogen, indication of contaminates/poor water quality from septic systems and disposal areas.; i.e.: 1243 old inlet rd. – more tidal influence – groundwater perching through the surface. Excavation – more presence of underlying organic layer – limit infiltration.
Better treatment – pretreatment systems – Bioclear, Advantex – use b/c of spatial constraints. Find a way to change that – provide incentives with use of pretreatment, and DWMP cluster systems. Upland areas.

Traditional systems $7000 advanced system $40-50-60k, expand loan program up to 50% of cost of installation.

Maintenance – inspections and incentives – rebrand and greater incentives.
Connectivity between programs – OneWater Program. Framework going to the board.
Curly street ocean outfall, Red Drum Outfall potential SCM/GSI stormwater projects

Support – 2017 project heavy. Focus shifted to repair work (aging infrastructure), converting upstream ends, green streets, road diet, green spaces. Connect to Comp plan.
WQ not being addressed more flood

Data loggers – continuous sampling needed. Data sharing online would provide support.
Not just one treatment measure – treatment train

Trees- conservation, preservation

Barriers – politics are a barrier.

Honest evaluation of data. What is the evidence? Tipping point. Messaging will be different moving forward. Monetary value, cost benefit analysis from NC Coastal Federation. Data can be alarming to public.

Wet weather- react – policy or project

Additional data? DENR Ocean outfall study – Rachael Noble.

GW lowering system – colony and nags head acres – quarterly and monthly data.

Interval storm events. Localized rainfall – weather station data

Increase credits for pump outs
Increase loan amounts, what is the cost of repair
Inspection – 3rd party inspection if people worried about gov't on property
Hard to tie water quality to program? Tie cause and effect to solution.
Concrete tangible action items – pump credit, loan, innovative solutions for incentivizing pretreatment or advanced systems for new construction
Range of system options for repair with costs, benefits**.**
Decentralized cluster systems – what would be the town's role? How would they be maintained?
Decentralized and central sewer might be too big of a shift, possibly too complicated at this time.

September 17, 2021
Town Staff

Incentivize LID
SWMP (stormwater management plan) needed for every lot, >500 sf increase in impervious
Meet with builder/contractor predevelopment – discuss topo, open space/tree save areas
SWMP does not need to be stamped by a PE
Template for docs developed in house to assist in determining calculations
Design Storm is 1-½" (coastal water quality standard)
Developers/contractors barriers are often it's too difficult and too time intensive. Repeat builders don't have as many issues
Additional costs

Most used measures:
#1 swale
#2 infiltration trench – drip line (perimeter french drain)

One of the stakeholders mentioned raingardens. How easy/difficult would it be to incentivize residential rain gardens? - year round – yes that would be great. Especially if they are a landscaper. Second homes might be more difficult too hard to maintain, landscapers just want to mow and be done.

~3,000 year-round residents, 40,000 peak. 2.5 people per home ~ 1200 homes year-round

Suggested bioswale or constructed wetland in public ROW
Stormwater affects functionality before systems. What are the relationships and education?
Barriers:

- better explain relationship
- LID- How does it help septic? Explain the how.
- Irrigation/water conservation
- Tree save areas (help with groundwater and water cycle) but many don't see that

LID big challenges are where you place things on a lot, and is it sitting correctly

iTree app

Tree types in NH:

- Loblolly Pine
- Live Oak
- Some sweet gum
- Some Atlantic red cedar
- Lots of understory

Water Quality monitoring:

Continuous monitoring would be good to capture water quality post storm events

What is the cost (HM to obtain type and cost)

What about in GW wells? (HM to obtain type and cost)

Publish data on town website? What data to use?

What is the bacteria indicator? Enterococci

People, Water, and Septic: A Coastal Case Study" UNC Fall 2019 Capstone Report Rachael Noble Study Red Drum Area has high nutrients? Why? Look at DA and flow.

From 2018 Capstone Report page 15, "Low-impact development techniques are suitable for areas that rely on septic systems as the wastewater treatment of choice since septic system functionality depends on soil saturation. If stormwater is not managed effectively, soils remain saturated and hinder septic system performance."

Community Questionnaire Survey Responses

Decentralized Wastewater Management Plan Update: *Community Questionnaire*

The purpose of this questionnaire is to gain insight from key stakeholders regarding the Town of Nags Head Decentralized Wastewater Management Plan Update and Todd D. Krafft Septic Health Initiative. The responses to this questionnaire will be used as a guide for the Plan Update and inform what additional incentives and programs should be added, revised, and/or removed under the Todd D. Krafft Septic Health Initiative.

History and Details:
In order to help homeowners continually maintain septic systems, the Town created a Septic Health Initiative in 2000 for residents who live and own houses in the Town of Nags Head. In 2005, the Town of Nags Head approved a Decentralized Wastewater Management Plan (DWMP) that more clearly outlined the importance of septic health, maintenance, and education in relation the region's water quality. And in 2019, the Septic Health Initiative was renamed in honor of Todd D. Krafft after his tireless efforts in promoting the program.

The Todd D. Krafft Septic Health Initiative provides:

- Free septic system inspections to single family residential homes within the Town of Nags Head
- A water bill credit in the amount of $45 for pumping out septic tanks
- Low interest loans for septic system repairs/replacement up to $7,500
- Septic system maintenance guidance and general education
- Groundwater and surface water quality testing

Fact: Did you know that over 80% of the Town's wastewater is treated by individual onsite residential septic systems and not central sewer?

Septic System Maintenance is like changing a car's oil, you need to change it every 3 months or 3,000 miles otherwise the engine will stop working. Septic systems are exactly the same! They need to be inspected and pumped out every 3 to 5 years, depending on usage. When a septic system fails it can cause bacteria and excess pollutants to enter our groundwater, stormwater, and surface water. These pollutants are carried out to the sound and ocean that can lead to beach closures and affect our quality of life.

1. **How familiar are you with the Town's Decentralized Wastewater Management Plan and Todd D. Krafft Septic Health Initiative as described above?**

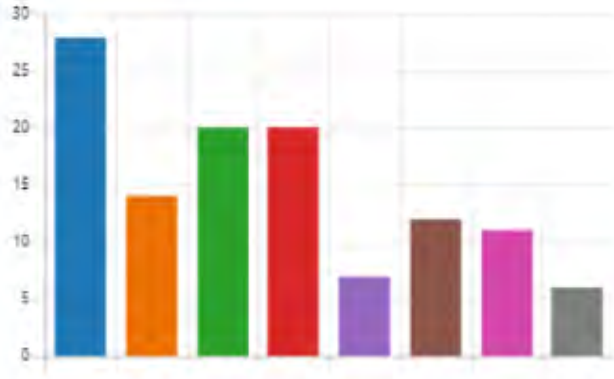
More Details Insights

Very familiar – I understand th...	26
Somewhat familiar – I've hear...	24
Not familiar – I didn't know ab...	20
Other	1

2. **How have you received information about the Town of Nags Head Todd D. Krafft Septic Health Initiative in the past?** *(check all that apply)*

More Details

Flyer	28
Water bill insert	14
Town webpage	20
Nags Head Lines (email newsl...	20
Word of mouth/neighbor	7
Have not received information...	12
I am a new resident/homeown...	11
Other	6



3. **Have you ever used the Town's free septic system inspection service, obtained a utility bill credit due to a septic tank pump out, and/or taken advantage of the Town's low interest loan program to repair or replace your septic system?** *(check all that apply)*

More Details

Inspection	29
Pump out- water bill rebate	18
Low interest loan	1
No/Not applicable	35
Other	4

4. **Do you feel the Todd D. Krafft Septic Health Initiative services currently being provided by the Town are beneficial to improve and increase septic maintenance?**

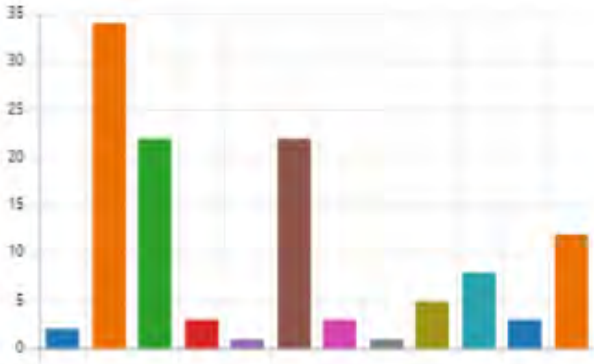
More Details Insights

Yes	54
No	0
Maybe	9
Not applicable/Not sure	5
Other	2

5. **What do you believe are barriers in regards to utilizing the current services and incentives offered by the Todd D. Krafft Septic Health Initiative?** *(check all that apply)*

More Details

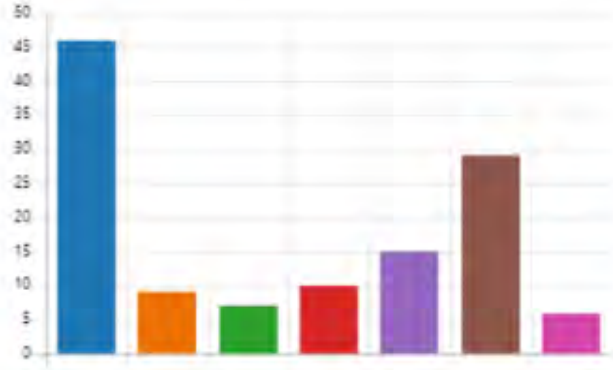
Didn't know I had a septic syst...	2
Unaware of the Town's Septic ...	34
Didn't know the septic inspect...	22
Septic inspection wait list time...	3
Not interested in an inspection	1
Process for obtaining utility bil...	22
Utility bill credit was too small...	3
Obtaining a loan through the ...	1
Uncomfortable with Town repr...	5
Managing septic system inspe...	8
Property management compa...	3
Other	12



6. **What additional or increased incentives would motivate you to participate in the Todd D. Krafft Septic Health Initiative maintenance program?** *(check all that apply)*

More Details

Increase septic tank pump out...	46
Provide free giveaways– toilet ...	9
Increase loan amounts and ex...	7
Offer grants for based on fina...	10
Consider promoting changes t...	15
Develop a voluntary septic sys...	29
Other	6



7. **What indicators do you consider helpful to inform you when a septic inspection or pump out is needed?** *(check all that apply)*

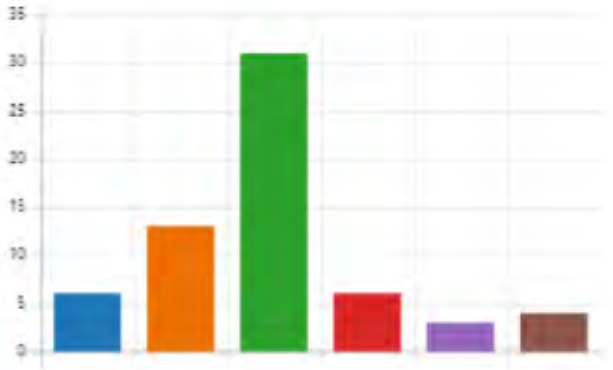
More Details

Set number of years since last ...	58
Problems with my system (bac...	18
Before or after rental season ...	13
After a large storm/flood	11
Other	1

8. **If you chose *"Set number of years since last inspection or pump out"* in the question above; on average how often do you regularly maintain your septic system (inspection, pump out, clean filter, etc.)?**

More Details

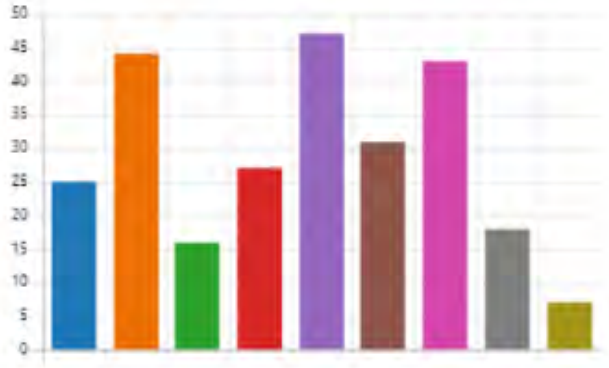
Annually	6
Every 2 to 3 years	13
Every 3 to 5 years	31
Occasionally	6
Never	3
Other	4



9. **What additional educational and outreach programs would better help you understand septic systems, general maintenance, and assist in being more proactive when it comes to septic health?** *(check all that apply)*

More Details

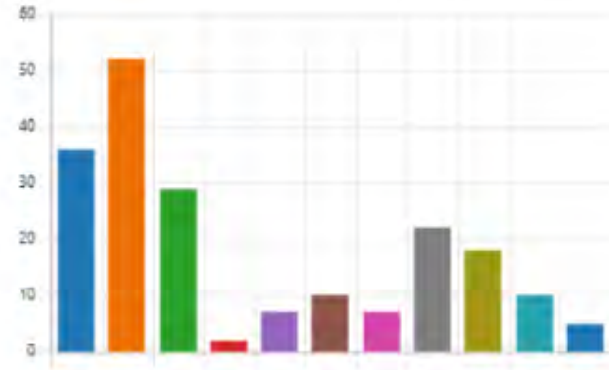
Provide a table with the cost b...	25
Provide guidance on best prac...	44
Provide guidance on how and ...	16
Explain how septic systems w...	27
Provide a welcome packet to ...	47
Provide online locational infor...	31
Provide information on what c...	43
Webinars and links to educati...	18
Other	7



10. **How can the Town best reach you to provide information about the Todd D. Krafft Septic Health Initiatives and septic maintenance?** *(check all that apply)*

More Details

Provide postcard flyers/mailers	36
Provide an opportunity to sig...	52
Provide additional informatio...	29
In-person workshops	2
Receive information in person ...	7
Neighborhood-level gatherin...	10
Local access radio public servi...	7
eNewspaper public service an...	22
Social media posts	18
Phone calls/texts	10
Other	5



11. **Do you think septic system failures affect water quality?**

More Details

Yes	62
No	0
Maybe	4
Not sure/Don't know	4
Other	0

12. **How would you rate the overall surface water quality of the ocean and sound in Nags Head?**

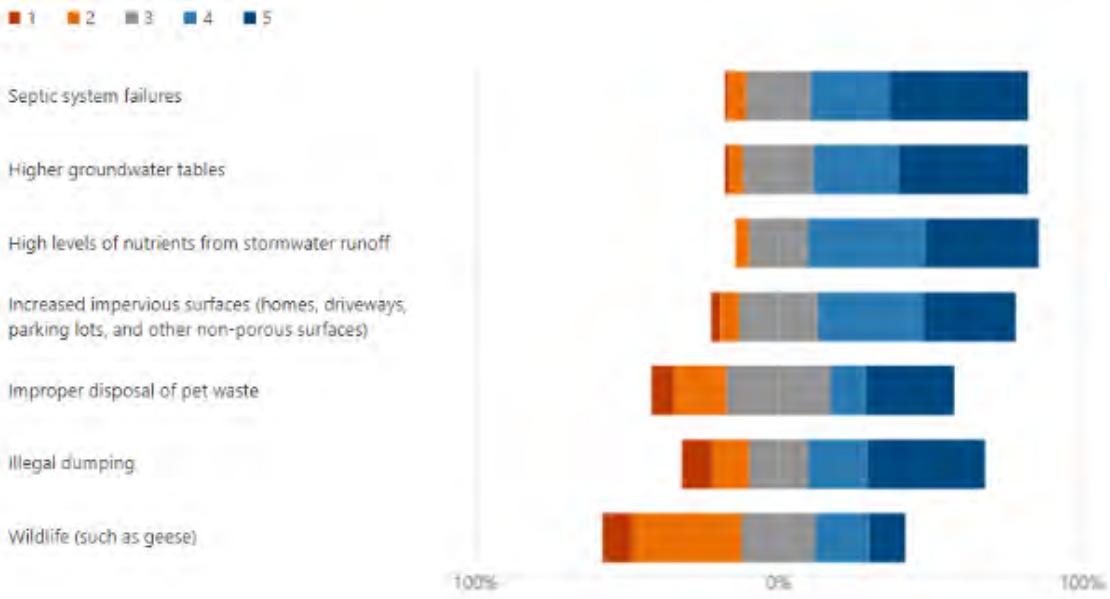
More Details Insights

69
Responses

★★★★☆
3.91 Average Rating

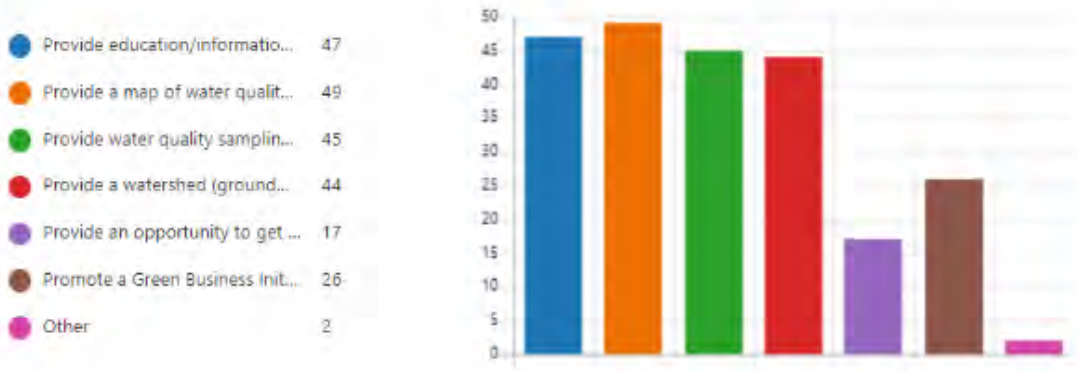
13. **How much of an impact do you feel the following factors have on water quality in Nags Head?**

More Details



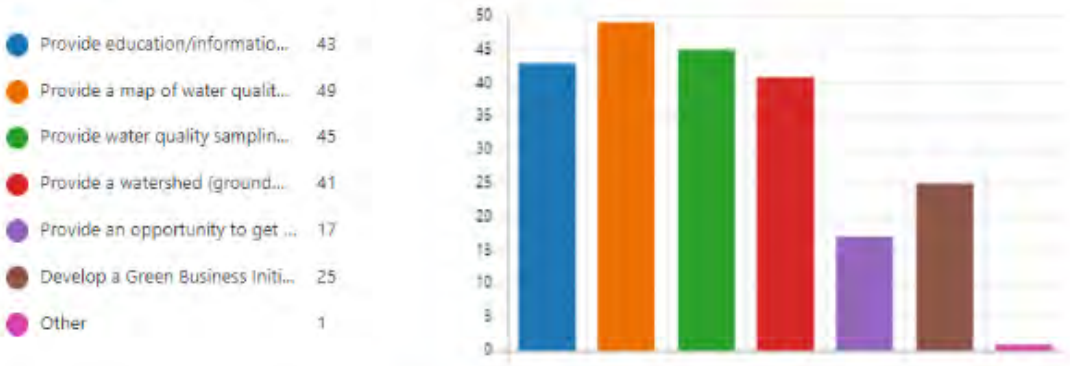
14. **What educational and outreach programs would you benefit from to related to local water quality and watershed health?** *(check all that apply)*

More Details



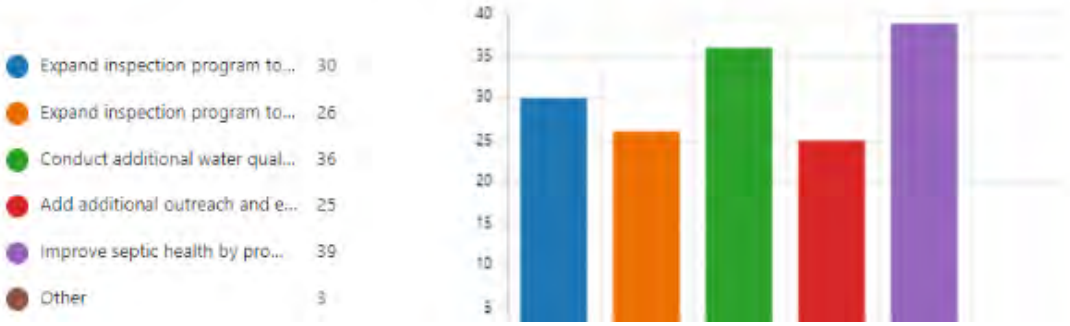
15. **What educational and outreach programs would you benefit from?** *(check all that apply)*

More Details



16. **What additional improvements would you like to see added to the Todd D. Krafft Septic Health Initiative program and Decentralized Wastewater Management Plan?** *(check all that apply)*

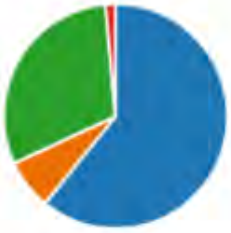
More Details



17. **Would you utilize a voluntary septic system subscription program created by the Town? The subscription could include scheduled annual inspections, assistance with maintenance, interpretation of inspection report, coordination and scheduling for septic pumping, coordination with Septic Health staff to manage pumping rebate, and other benefits.**

More Details Insights

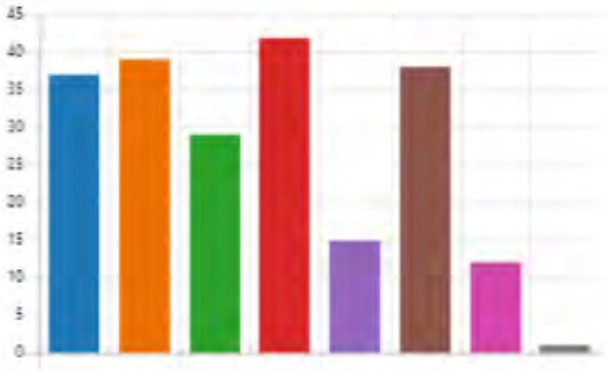
Yes	42
No	5
Maybe	21
Other	1



18. **What types of benefits would you be most interested in from a septic system subscription program?** *(check all that apply)*

More Details

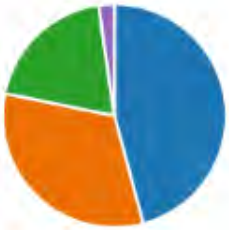
Yearly inspection	37
Coordination of pumping for ...	39
Post pumping inspection (mor...	29
Notification of potential probl...	42
One-on-one septic informatio...	15
Greater discount on pumping ...	38
Staff management of septic p...	12
Other	1



19. **What impacts do you think rising groundwater elevations, more frequent high intensity rainfall events, and more frequent hurricanes have on septic system function?** *(check all that apply)*

More Details

Increases in septic system fail...	61
Increased need for septic syst...	43
Need for off-site small or larg...	26
None/Not applicable	0
Other	3



20. Choose the statement that best describes how you use your home:

More Details

Full time resident	25
Second homeowner, but do n...	12
Second homeowner and only ...	4
Second homeowner and rent ...	28
Other	0

21. Street Name

More Details Insights

67
Responses

Latest Responses
"S. Memorial Avenue"
"S Cobia Way"
"South Memorial"

11 respondents (**17%**) answered **Linda Lane** for this question.

22. Age of home

More Details Insights

65

Responses

Latest Responses

"18 years"

"33"

"10 years"

28 respondents (**44**%) answered **years** for this question.

23. Age of septic system

More Details Insights

65

Responses

Latest Responses

"18 years"

"don't know"

"10 years"

25 respondents (**40**%) answered **years** for this question.

24. Last septic system inspection (approximate date MM/YYYY)

More Details Insights

62
Responses

Latest Responses
"2018"
"don't know"
"06/2020"

2 respondents (**3**%) answered **Never** for this question.

25. Last septic pump out (approximate date MM/YYYY)

More Details Insights

63
Responses

Latest Responses
"2018"
"don;t know"
"06/2020"

4 respondents (**7**%) answered **Not Sure** for this question.

Public Forum live poll via Poll Everywhere Responses

Question 1: Approximately where do you live or where is your home in Nags Head?

Powered by Poll Everywhere

Start the presentation to see live content. For screen share software, share the entire screen. Get help at pollev.com/app

Question 2: How has your septic system been functioning in the last 3 to 5 years?

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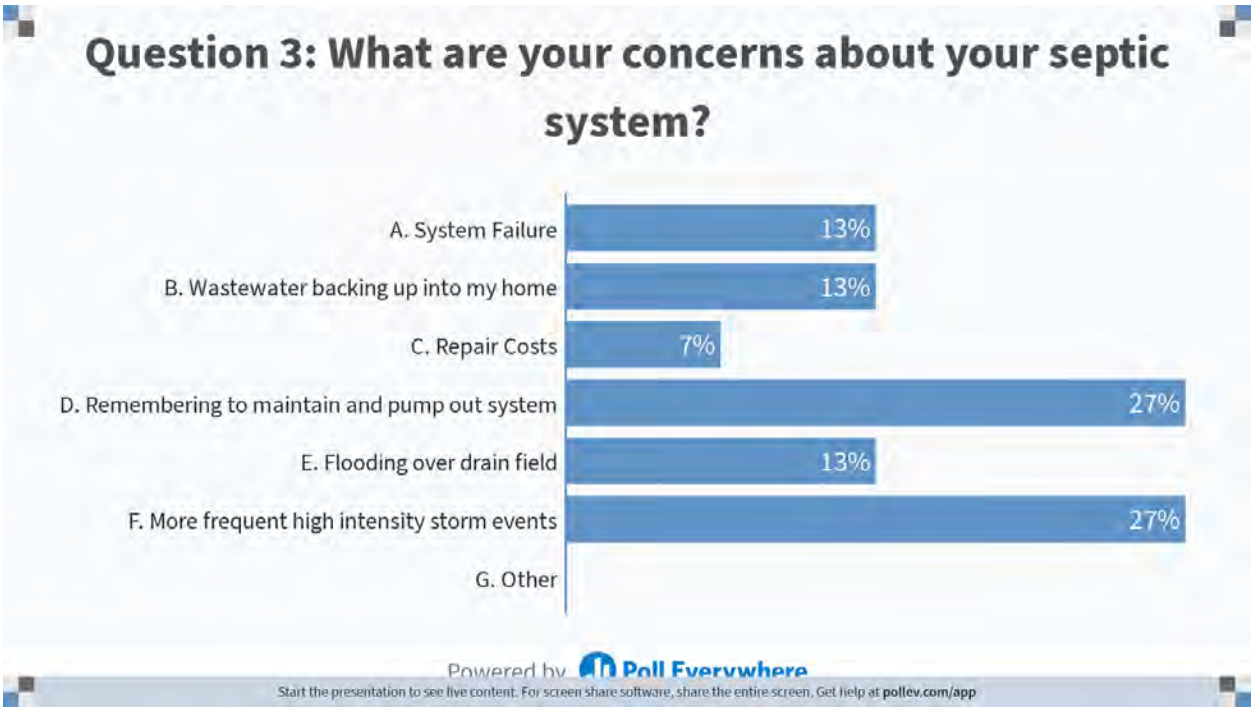
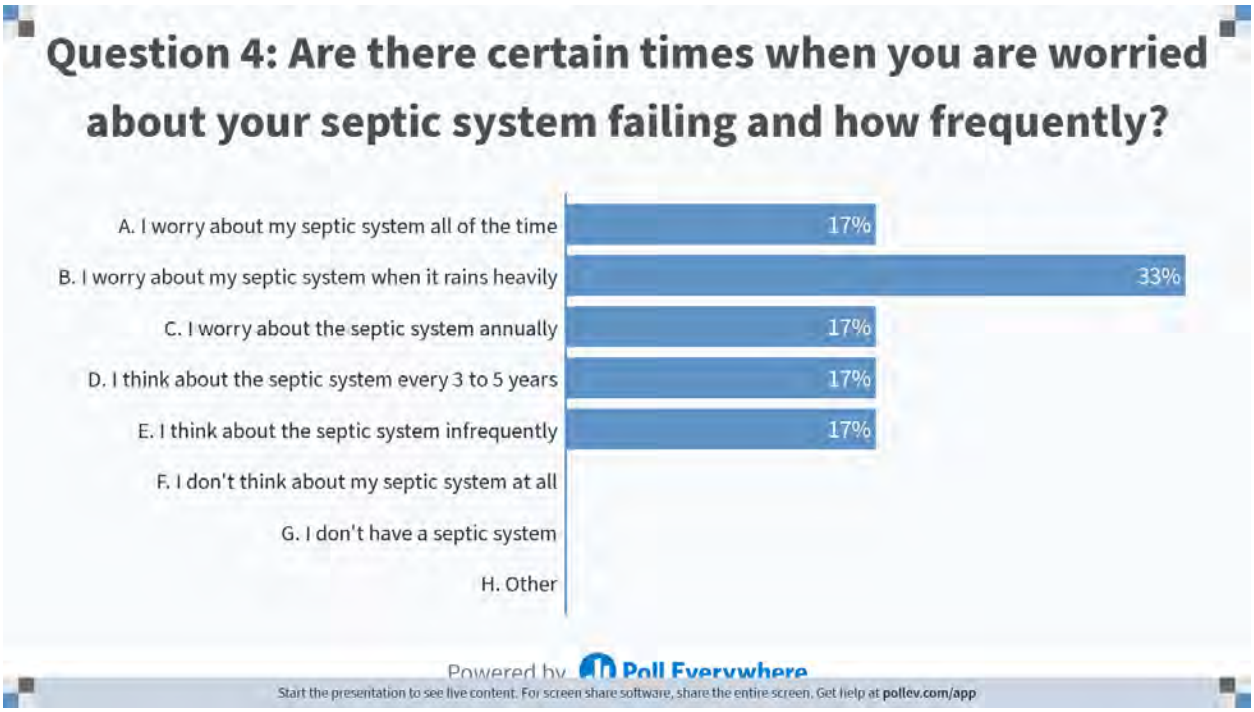

Question 3: What are your concerns about your septic system?
A. System Failure
13%
B. Wastewater backing up into my home
13%
C. Repair Costs
7%
D. Remembering to maintain and pump out system
27%
E. Flooding over drain field
13%
F. More frequent high intensity storm events
27%
G. Other
Powered by Poll Everywhere
Start the presentation to see live content. For screen share software, share the entire screen. Get help at pollev.com/app


Question 4: Are there certain times when you are worried about your septic system failing and how frequently?
A. I worry about my septic system all of the time
17%
B. I worry about my septic system when it rains heavily
33%
C. I worry about the septic system annually
17%
D. I think about the septic system every 3 to 5 years
17%
E. I think about the septic system infrequently
17%
F. I don't think about my septic system at all
G. I don't have a septic system
H. Other
Powered by Poll Everywhere
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Question 5: What activities do you conduct to ensure your septic system is functioning properly?

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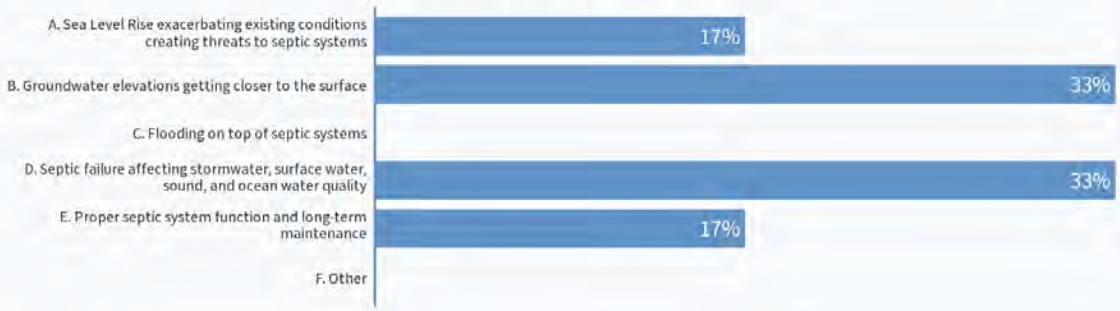
Question 6: Now that you are more familiar with the groundwater and water quality data, what do you think the most pressing issues are related to septic system function and management?



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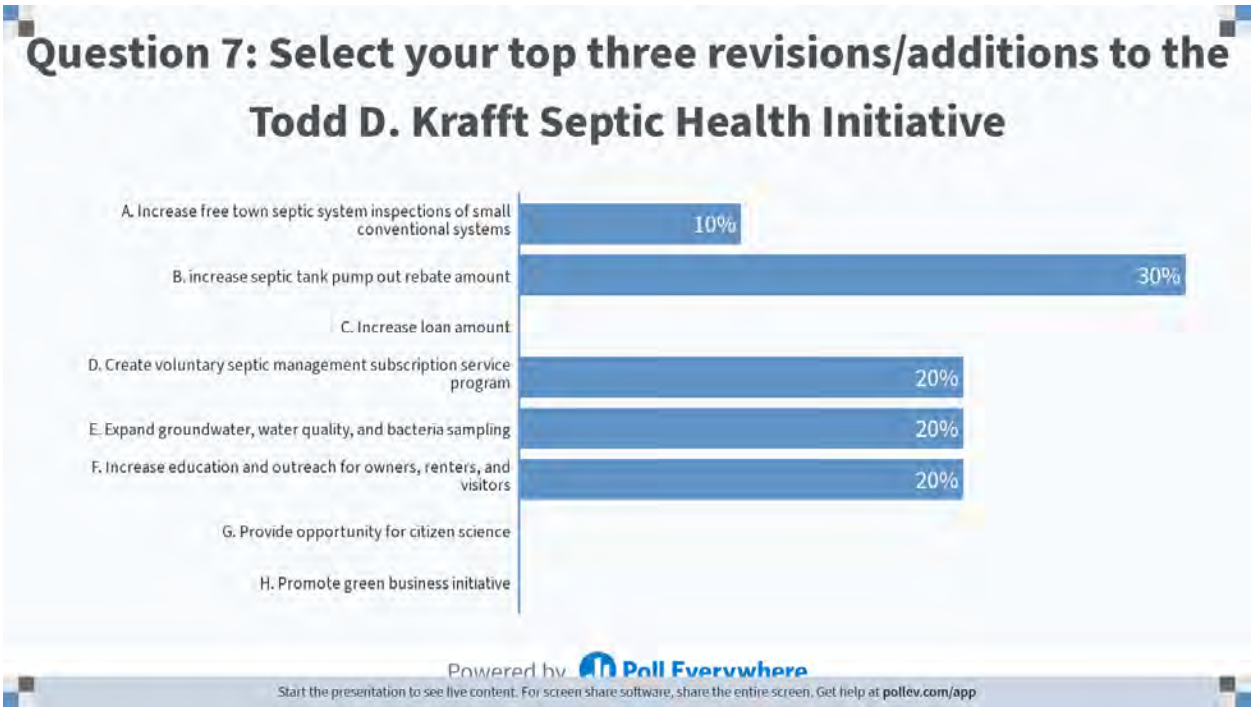
Question 7: Select your top three revisions/additions to the Todd D. Krafft Septic Health Initiative
A. Increase free town septic system inspections of small conventional systems
10%
B. increase septic tank pump out rebate amount
30%
C. Increase loan amount
D. Create voluntary septic management subscription service program
20%
E. Expand groundwater, water quality, and bacteria sampling
20%
F. Increase education and outreach for owners, renters, and visitors
20%
G. Provide opportunity for citizen science
H. Promote green business initiative
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Question 8: What is your perception of the Town's Decentralized Wastewater Management Plan and Todd D. Krafft Septic Health Initiative?
save)the)thown
informative
nags
problem
nice
now
bigger
best
head
done
thank
addressing
excellent
job
think
presentation.
needsmoreeducationandgrrsterimportance
Powered by Poll Everywhere
Start the presentation to see live content. For screen share software, share the entire screen. Get help at pollev.com/app

APPENDIX C. Decentralized Cluster Systems

The following images and infographics are intended to illustrate existing large-scale onsite wastewater treatment systems across Nags Head that represent the appropriate scale for applicability of small and large decentralized cluster systems for single-family residential homes Figure C- 1, Figure C- 2, Figure C-3). Cluster systems are ideal for neutralizing effluent across homes with variable waste flows due to changing residents and for serving existing residences that are in higher risk neighborhoods. When waste flow volume is at minimum 5,000 – 10,000 gallons per day, opportunities for cluster systems can support 10 – 20 typically-sized single-family residential homes, given the space for sizing and contiguous area, and additional design requirements for larger systems. Design flows for residences are based on the number of bedrooms times 120 gallons per day (GPD) per bedroom. So, a three-bedroom residence would have a design flow of 360 GPD and a four-bedroom residence would be 480 GPD.

In Figure C- 1, the top image illustrates three adjacent single-family residences which are each 12-bedroom homes with separate LPP systems in Nags Head. Three 12-bedroom homes are approximately 1,440 GPD each which could serve four 3-bedroom homes, or if combined could represent a 4,320 GPD cluster system that could serve twelve 3-bedroom homes. The bottom image is of a single 10-bedroom residence on an LPP system that could represent the size and type of system to serve 3+ 3-bedroom homes.

Figure C- 2 shows examples of large and/or advanced onsite wastewater systems that provide analogous treatment scale or volume to larger scaled cluster systems. The upper left picture is of the decentralized system that serves the Outlets at Nags Head. This is a 13,000 GPD system like the size and type that could serve 27-36 homes. The Satterfield Landing commercial system is an advanced treatment using the Bioclere™ wastewater treatment system followed by an LPP drain field. The design flows for this system are 10,200 GPD, which could represent 21-28 homes. The lower picture is of the Town of Nags Head's Municipal Complex wastewater treatment system, which is an LPP system with design flows of 3,000 GPD, similar to the size needed for 6-8 homes.

In Figure C- 3, three large-scale non-residential advanced onsite systems are shown from across Nags Head. These large systems show various treatment types and provide a general idea of the drain field size needed to accommodate large scale systems. The upper image is of the Comfort Inn South Oceanfront system which includes a Bioclere™ advanced treatment system followed by an LPP drain field. This system has a design flow of 13,500 GPD, like the size needed for 28-37 homes. The lower image is of the system serving the First Colony Inn. This system is 5,500 GPD design flow and could serve around 11 homes.

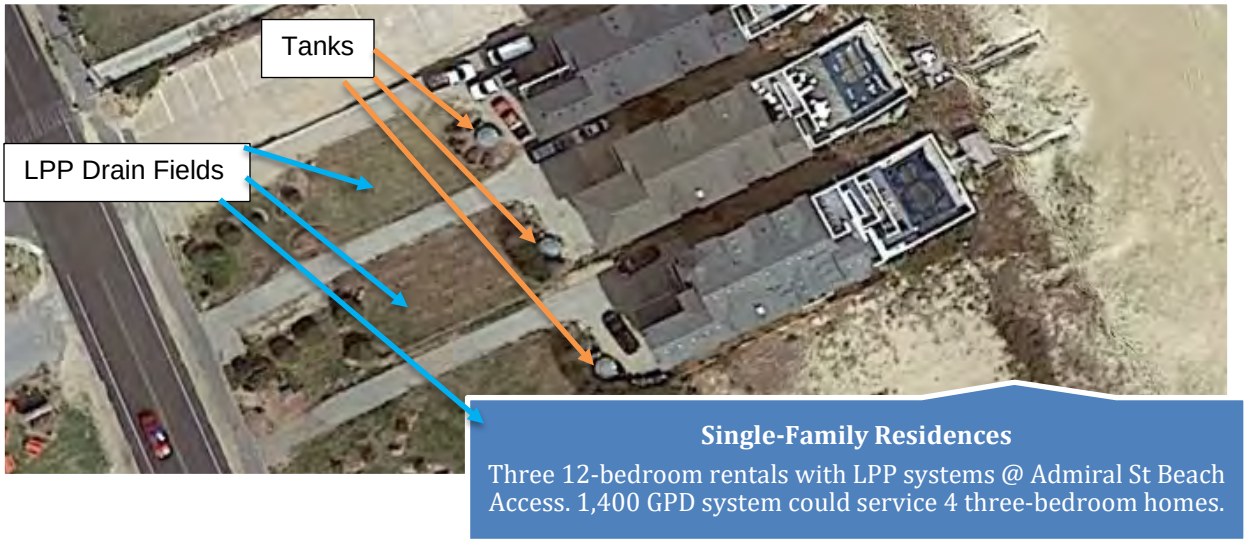

Figure C- 1. Examples of large and/or advanced onsite wastewater systems at large residential sites that provide analogous treatment scale or volume to smaller-scale or clustered residential decentralized cluster system opportunities.

Figure C- 2. Examples of large and/or advanced onsite wastewater systems at commercial and municipal sites that provide analogous treatment scale or volume to residential decentralized cluster system opportunities.

Figure C- 3. Examples of large and/or advanced onsite wastewater systems at hotel sites that provide analogous treatment scale or volume to residential decentralized cluster system opportunities.

APPENDIX D. Advanced Septic System Treatment Options

Advanced treatment options outlined can be used in the future to aid in determining the most viable wastewater treatment system based on the evaluation criteria suitability. The options allow for septic system treatment to be installed where conventional systems will not work, and areas are experiencing high risk. Each option has varying levels of operation and maintenance.

Treatment alternatives and advanced systems include a wide variety of solutions including but not limited to:

- Addition of pump station following the septic tank to lift the drain field higher in the soil profile or to provide equal distribution throughout the drain field using low pressure pipes (LPP)
- Addition of Advanced Treatment Units (ATUs) prior to the drain field provide treatment up front and allow for reductions in separation to the groundwater table and for reductions in the size of the drain fields
- Alternative drain fields exist including drip distribution or various piping combinations of treatment and dispersal drain fields.
- Water reuse onsite (grey water) can be separated out of the wastewater stream to treat and reused onsite in toilets and for irrigation. Note: this option can be a costly retrofit for existing homes. Overall, water reuse can lower water usage, lower water bills, and reduce drain field sizing needs.
- Wastewater can also be pumped offsite, treated in a pond or open space, and recirculated back to the homes or the water treatment plant.
- Decentralized off-site wastewater treatment cluster system options. This may range from combining several properties and pumping to a nearby suitable drain field area, combining entire subdivisions into cluster systems, and including water recirculation/reuse with options both onsite and offsite.

Option 1: Residential LPP with mounded dispersal field (no pretreatment required)

Option 1 forgoes advanced onsite treatment systems for mounded dispersal where depth to groundwater is limiting for conventional at-grade systems. This management option is best suited for larger parcels in low density areas that are not located in close proximity to impaired water quality areas since the effluent quality will not be as high as Options 2 and 3. Option 1 may also be used as a potential temporary solution for systems in areas considered high risk for sea level rise and the investment in higher cost treatment/conveyance infrastructure is not justified.

Evaluation Criteria Suitability:

1. Parcel Mean Sea Level Elevation – Low
2. Groundwater Elevation – 12” or less (18” min separation to top of fill)
3. Groundwater Quality - High
4. Surface Water Quality - High
5. Parcel Density – Low
6. Parcel Size - Larger
7. Density of Failing Septic Systems - Low
8. Age of Existing Septic System – N/A
9. Density of Existing Onsite Pretreatment Systems - High
10. Proximity to Publicly Owned or Open Space Areas – Low

Option 2: Onsite ATU Systems with conventional, drip, or LPP dispersal (native or modified soil)

Where parcel density and other factors limit the feasibility of community collection sewers, but higher-quality septic effluent is important, Option 2 is an septic management solution that utilizes Advanced Treatment Units for treatment and increased effluent quality. Onsite dispersal system type, which could include either conventional/alterative trenches, LLP, or drip distribution, would depend on site specific soil and groundwater conditions. These systems require design by a professional engineer and an operation and maintenance contract between the owner and a certified septic system operator. Typically, four (4) inspections are required per year.

Evaluation Criteria Suitability:

1. Parcel Mean Sea Level Elevation - Average
2. Groundwater Elevation – 12”-36”
3. Groundwater Quality - Poor
4. Surface Water Quality - Poor
5. Parcel Density – Average to Low
6. Parcel Size – Average to Large
7. Density of Failing Septic Systems - High
8. Age of Existing Septic System - Average
9. Density of Existing Onsite Advanced Treatment Systems - High
10. Proximity to Publicly Owned or Open Space Areas - Low

Option 3: Onsite Reuse Quality Non-Discharge 2U Standards (NC DHHS) at grade dispersal w/shallow drip

Option 3 is a more costly onsite management approach that will treat wastewater effluent to 2U reuse standards for at-grade dispersal via shallow drip. These systems would be permitted by NC DHHS but would need to meet the effluent quality standards in the 2U Rules. Option 3 systems are most suitable for larger parcels in lower density areas with shallow water tables and near to impaired water quality areas. Professional design and certified operators required.

Evaluation Criteria Suitability:

1. Parcel Mean Sea Level Elevation – Low to Average
2. Groundwater Elevation – 12” or less
3. Groundwater Quality - Poor
4. Surface Water Quality - Poor
5. Parcel Density – Low
6. Parcel Size - Larger
7. Density of Failing Septic Systems - High
8. Age of Existing Septic System – N/A
9. Density of Existing Onsite Pretreatment Systems - High
10. Proximity to Publicly Owned or Open Space Areas - Low

Option 4: Community Collection Sewer w/Type I/II Non-Discharge Treatment System (NCDHHS Permit Review)

This option involves “clustered” wastewater management system with collection sewer and strategically located non-discharge dispersal system. Depending on wastewater characteristics and available soil dispersal area, an advanced treatment system may or may not be required beyond septic tank pretreatment. As such, Option 4 would be prioritized over Option 5 where water quality impairment is not as critical within the surrounding area. Since Option 4 would involve subsurface dispersal of effluent, it would be permitted by Dare County, but the design plans would need to be engineered and reviewed NC DHHS. Systems included in this option would likely be permitted as Large Wastewater Systems (i.e.,

design flow greater than 3,000 gpd) since investment in collection sewer would require the economy-of-scale obtained beyond this design volume threshold.

Evaluation Criteria Suitability:

1. Parcel Mean Sea Level Elevation - Low
2. Groundwater Elevation – 24” or less
3. Groundwater Quality - Average
4. Surface Water Quality - Average
5. Parcel Density – High
6. Parcel Size - Small
7. Density of Failing Septic Systems - High
8. Age of Existing Septic System - Average
9. Density of Existing Onsite Pretreatment Systems - Low
10. Proximity to Publicly Owned or Open Space Areas – High

Option 5: Community Collection Sewer w/ Reuse Quality Non-Discharge 2U Treatment System (NC DEQ Permit)

Option 5 involves installation of localized collection sewers that convey raw sewage or septic tank effluent to a “cluster” treatment system for “non-discharge” dispersal. The collection sewer could consist of a combination of gravity or pressure sewer depending on specific site conditions, although a Septic Tank Effluent Pump (STEP) system for all users should be assumed for preliminary cost comparisons. The treatment system will be designed for compliance and permitting through the NC DEQ Non-Discharge Permitting Branch under their 2U rules, which will provide reuse quality water that can be land applied (e.g., landscape irrigation, car washing, etc.). Overall, this management option will be optimal in high density areas of Nag’s Head in close proximity to impaired groundwater/surface waters, and suitable for zones of high risk to sea level rise. It would be used in the case the no other option exists.

Evaluation Criteria Suitability:

1. Parcel Mean Sea Level Elevation - Low
2. Groundwater Elevation – 12 inches or less
3. Groundwater Quality - Poor
4. Surface Water Quality - Poor
5. Parcel Density – High
6. Parcel Size - Small
7. Density of Failing Septic Systems - High
8. Age of Existing Septic System - Older
9. Density of existing Onsite Pretreatment Systems - Low
10. Proximity to Publicly Owned or Open Space Areas – High

APPENDIX E. Resources and References

Resources

Town of Nags Head VCAPS Report

Town of Nags Head Comprehensive Plan

Town of Nags Head Stormwater Master Planning

Town of Nags Head Stormwater Master Plan Map

Town of Nags Head Code of Ordinances, Chapter 34 Stormwater Fill and Runoff Management

Town of Nags Head Decentralized Wastewater Management Plan and Technical Report (2005), Stone Environmental

Coastal Hazards Infrastructure Vulnerability Assessment, Duck, NC, 2020

Town of Nags Head Low Impact Development - Best Management Practices Manual/ Solutions to Mitigating Stormwater Runoff, 2015

Town of Nags Head Water Conservation Measures for Decreased On-Site Wastewater System Performance During Periods of Heavy Rainfall

Huron River WSC Detection and Rectification of Failing Septic Systems, 2013

Miami-Dade County Septic Systems Vulnerable to Sea Level Rise, 2018

USGS Ground Water ATLAS of the US, North Carolina

National Oceanic and Atmospheric Administration (NOAA). 2017. Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083

Outer Banks Regional Hazard Mitigation Plan, 2020

NC DEQ Climate Science Report, 2020

Vermont Lake Wise Program

US EPA Septic System Guidance, Policy, and Regulations

NC DEQ Division of Water Resources Water Quality Permitting, NPDES Wastewater

NC DHHS EHS On-Site Wastewater Treatment Branch

Dare County Environment Health Services On-site Water Protection

NCSU Septic Systems and Their Maintenance

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Fall 2018 "Environmental Change and Septic Systems in Nags Head: Local Perspectives and Impacts on Water Quality and Quantity" UNC Capstone Report (1st Year of Study)

2013 "Nags Head Acres Evaluations and Suggestions About Stormwater and Septic Tank Management Among Residents of Nags Head Acres" – East Carolina University

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US EPA Voluntary National Guideline for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems, March 2003

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